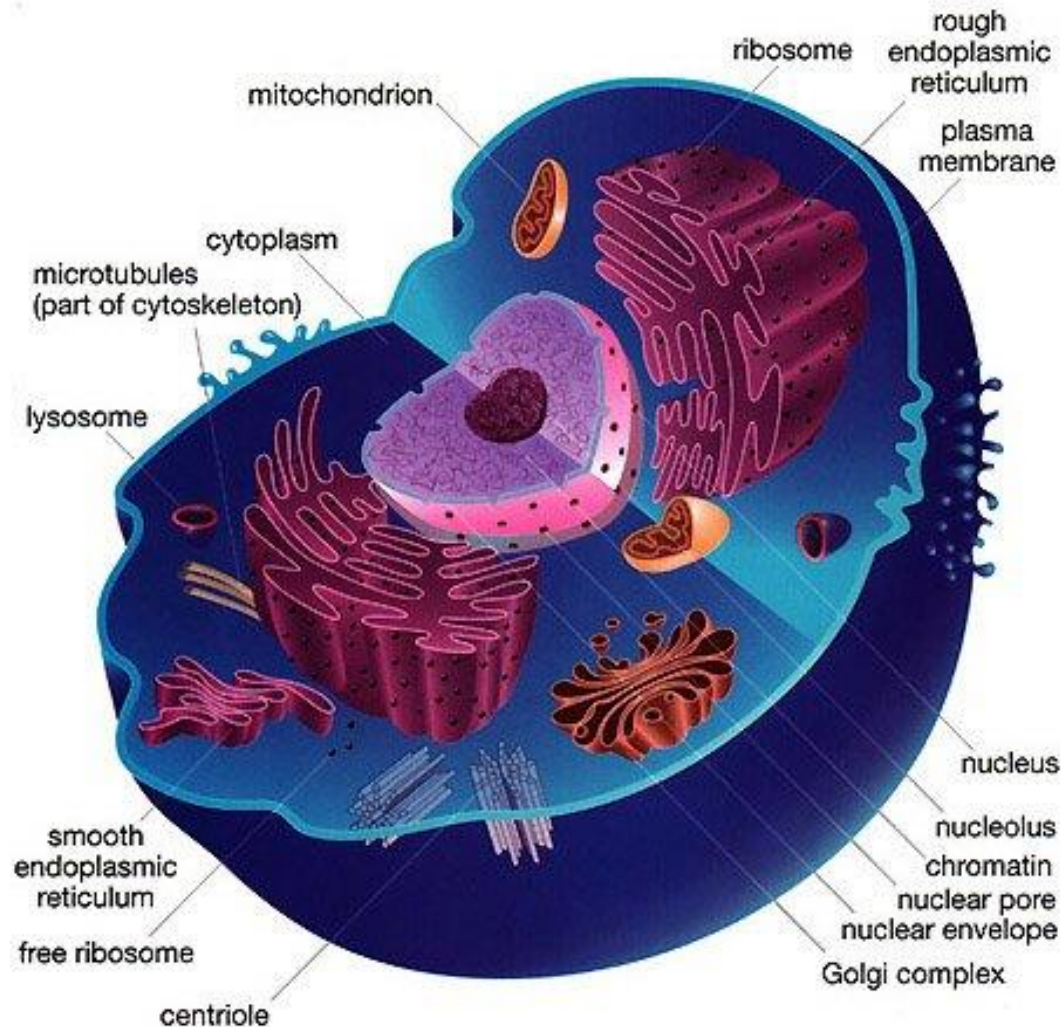




Cambridge Assessment AS Level International Education Chapter 1

Cell Structure



Chapter Outline

Part 1: Microscopy

- Magnification vs Resolution
- Light Microscope vs Electron Microscope

Part 2: Micrometry: How do we measure cells?

- Calibrating EPG using the Stage Micrometer (Practical 1)
- Magnification

Part 3: Cell Structure and Function

- Organelles
- Animal vs Plant cells
- Eukaryotes vs Prokaryotes
- Viruses



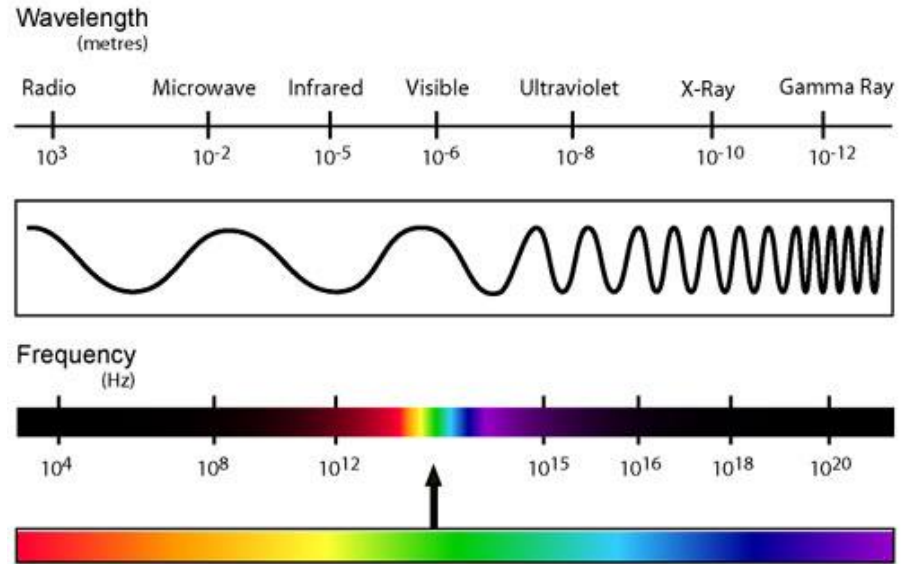
MICROSCOPY

LIGHT
MICROSCOPES
AND ELECTRON
MICROSCOPES

Types of Microscopes

- Electromagnetic radiation (light / electrons)
→ Image of specimen

THE ELECTRO MAGNETIC SPECTRUM

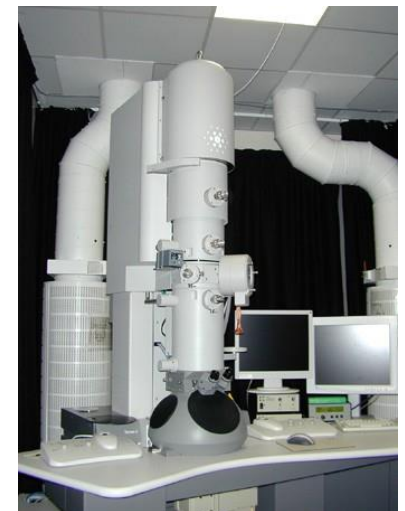


1. Light microscope

2. Electron microscope

a) Transmission Electron Microscopes (TEM)

b) Scanning Electron Microscopes (SEM)



Magnification and Resolution

1) Magnification

- **Number of times an image is enlarged,** compared with the actual size of the object
- “**x**” sign placed in front of number



2) Resolution

- **Ability to distinguish between two points clearly as separate**
- Units in **nm**

Increase in magnification $\neq$ increase in resolution

Magnification



naked eye



4x magnification



6x magnification



8x magnification

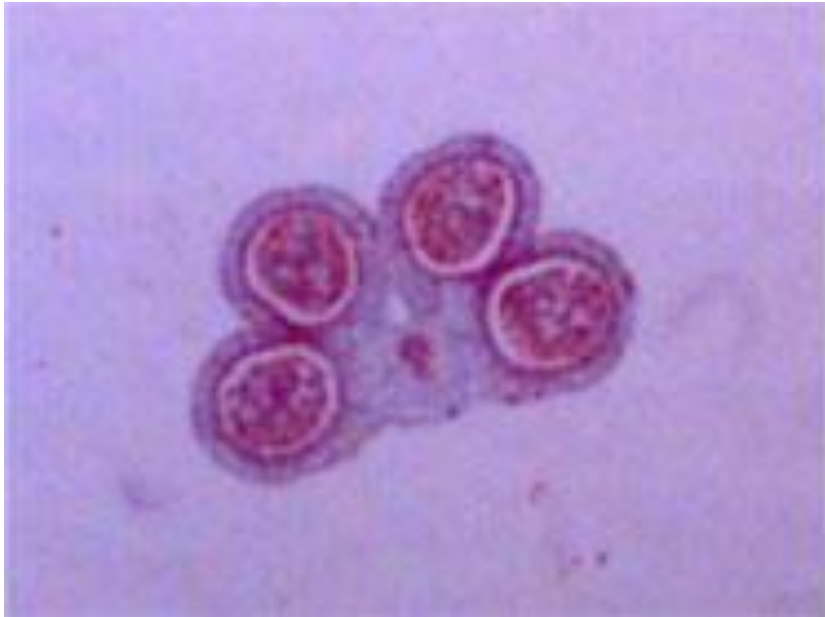


10x magnification



20x magnification

Resolution



High resolving power



Low resolving power

What determines resolution?

- Range of electromagnetic radiations of different wavelengths

→ Electromagnetic spectrum

- **Shorter wavelength used**
→ **Higher resolving power**

→ Wavelength of visible **light** is longer than of an **electron**

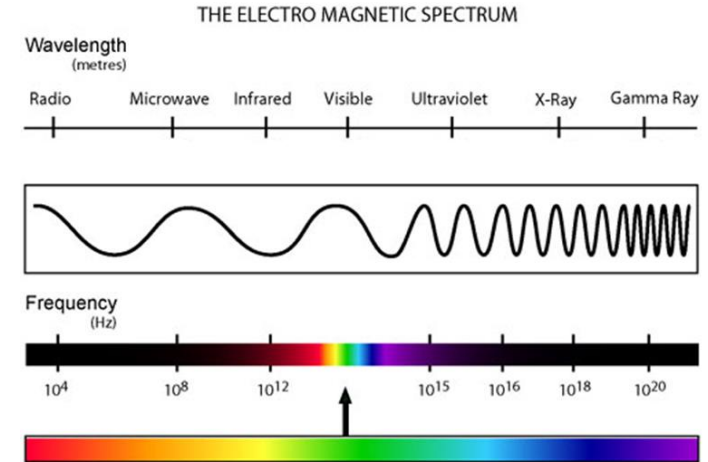
→ Ability to distinguish between two points is lower

- **Max** resolution is the...

→ **Shortest distance** between 2 separate points

→ The max resolution = $\frac{1}{2}$ wavelength used

→ Shorter wavelength = higher max resolution = lower resolution



Resolution

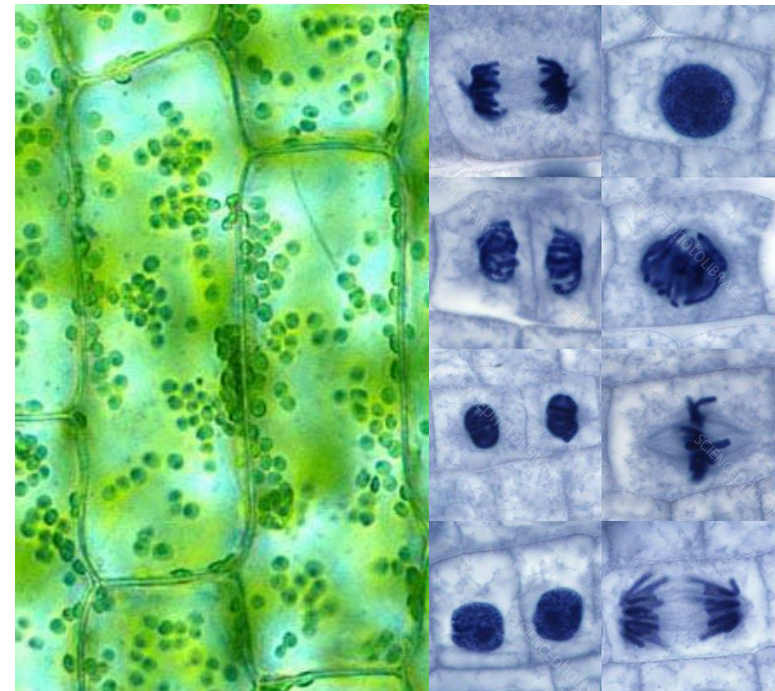


For example:

- **Max** resolution is the...
- **Shortest distance** between 2 separate points
- The max resolution = $\frac{1}{2}$ wavelength used
- Wavelength of visible light = 400-700nm
- Max resolution of a light microscope = 200nm
- If closer/smaller than 200nm, points **cannot** be distinguished **as separate**
- Can a ribosome (smallest organelle) of 25nm be seen?

Light Microscope

- Source of electromagnetic radiation: **Visible light**
- Wavelength = approx. 400-700nm
- Lower energy and **longer wavelength** than electrons
- Focused using mirrors and glass lenses
- Highest magnification: **x1,500**
- Max resolution : **200nm** (low)
- Advantage: **Live** specimens can be viewed, image can be coloured

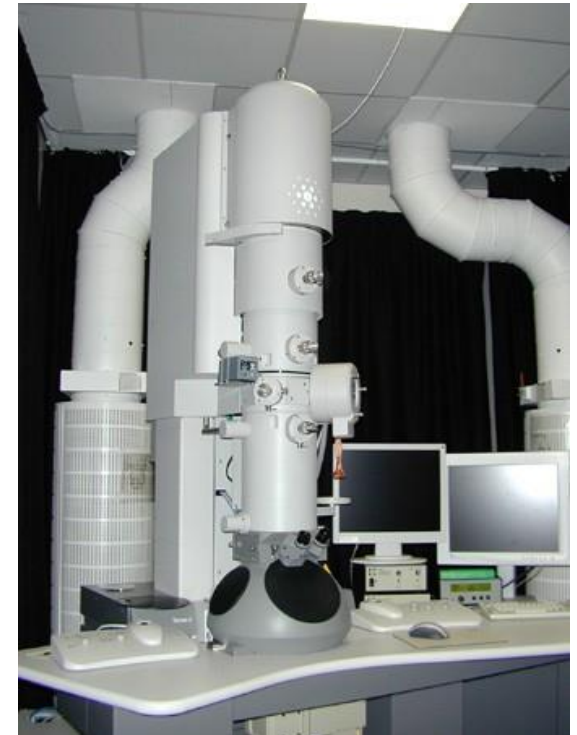


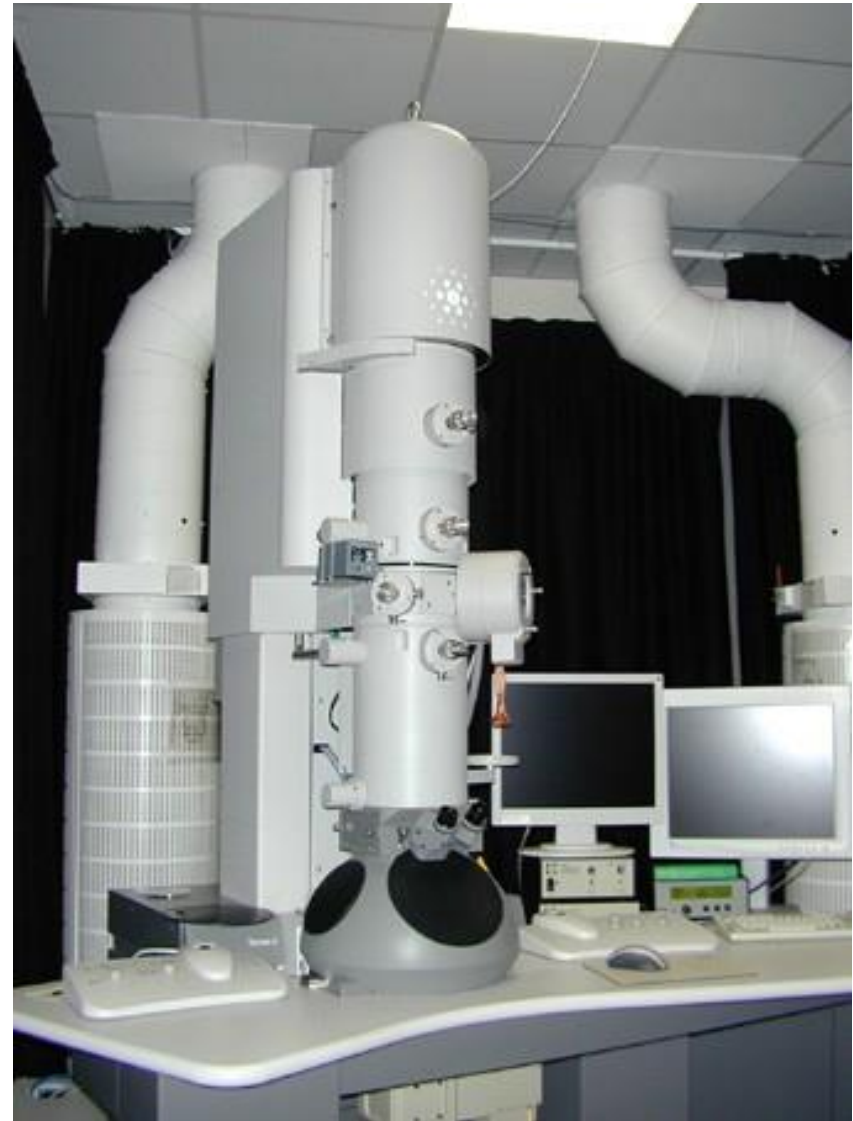
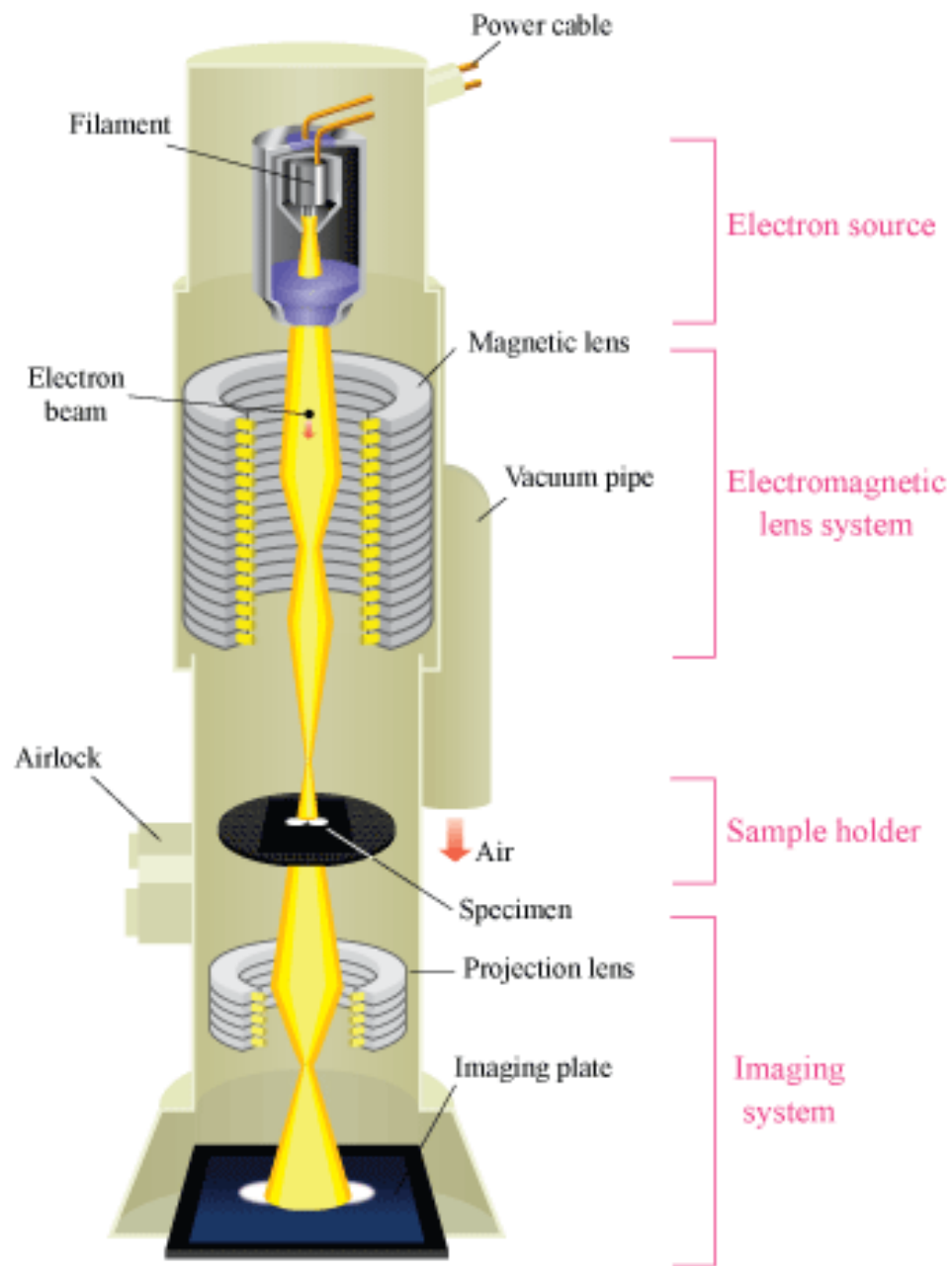
*Used for viewing structures that can be measured in **μm***

Electron Microscope

- Source of electromagnetic radiation: **Free electrons**
 - Wavelength = approx. 1 nm
 - High energy, very **short wavelength**
 - Must be in a **vacuum** environment so electron can travel in straight lines
 - Use electromagnetic lenses
- Highest magnification: **x250,000**
- Max resolution: **0.5 nm** (high)
- Disadvantage: Only **dead material** can be examined in vacuum, images are **black and white**

*Used for viewing structures that can be measured in **nm***

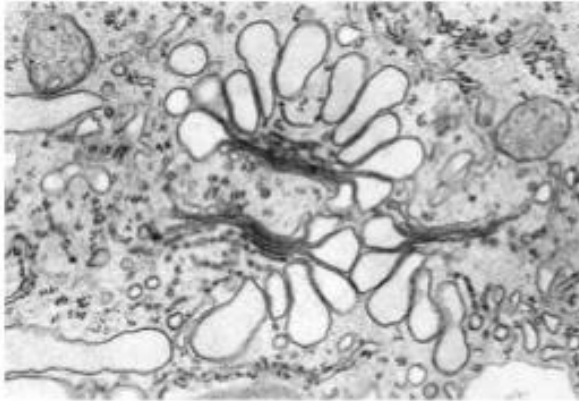




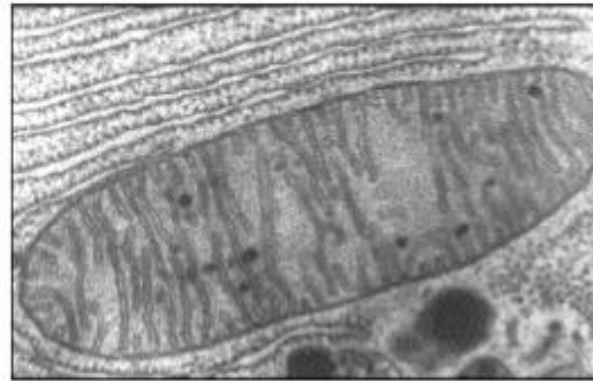
Types of Electron Microscopes

a) **Transmission** Electron Microscopes (TEM)

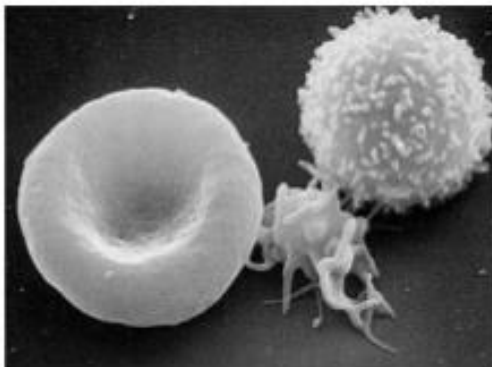
b) **Scanning** Electron Microscopes (SEM)



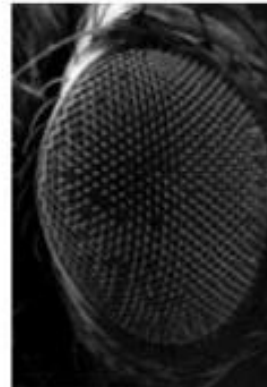
TEM image of golgi complex



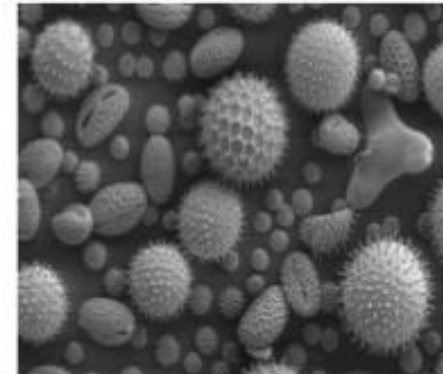
TEM image of mitochondria



SEM image of blood cells



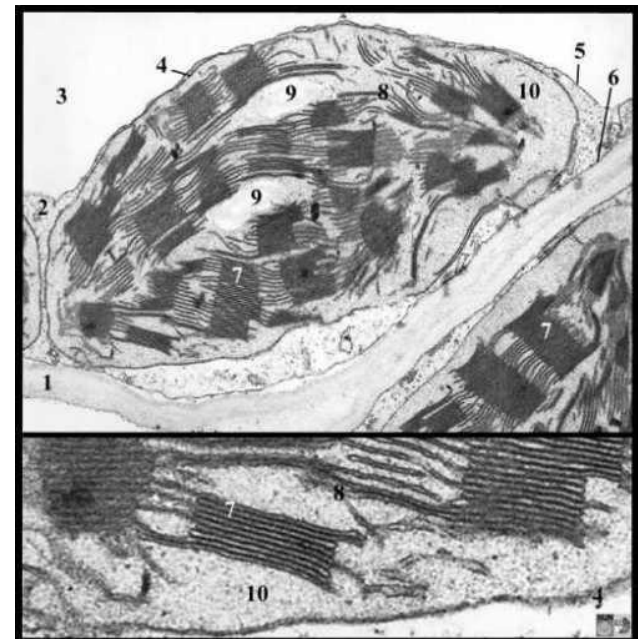
Drosophila's eye.



SEM image of pollen grains

Transmission Electron Microscopes

- Beam of electrons
- Pass through (transmit) specimen before being viewed
- **2D** appearance
- Details inside cells
 - **Internal structures**
 - **Membranes within internal structures**



Scanning Electron Microscopes

- Lower resolution compared to TEM
- Scan **surfaces** of specimens
- **3D** appearance



Q: List the differences between a light microscope and an electron microscope. [4]

This is how you should ALWAYS present your answer to compare/contrast between 2 things.

Features	Light Microscope	Electron Microscope
E.g. Highest magnification of microscope	Low <u>er</u>	High <u>er</u>

- **4 marks = 4 points** (1 mark is for table plus 1 just in case)
- *DO NOT* tick or cross in the box.
- Use **comparative** language.
- Make your “Feature” as **specific** as possible.
(e.g. instead of magnification, write highest magnification of microscope)

Q: List the differences between a light microscope and an electron microscope. [4]

A:

Features	Light Microscope	Electron Microscope
Type of radiation	Light	Electrons
Radiation travels through	Air	Vacuum
Wavelength of radiation	Longer 400-700 nm	Shorter 1 nm
Highest magnification of microscope	Lower x1500	Higher x250,000
Max. resolution of microscope	Lower 200 nm	Higher 0.5 nm
State of specimen	Live	Dead



MICROMETRY

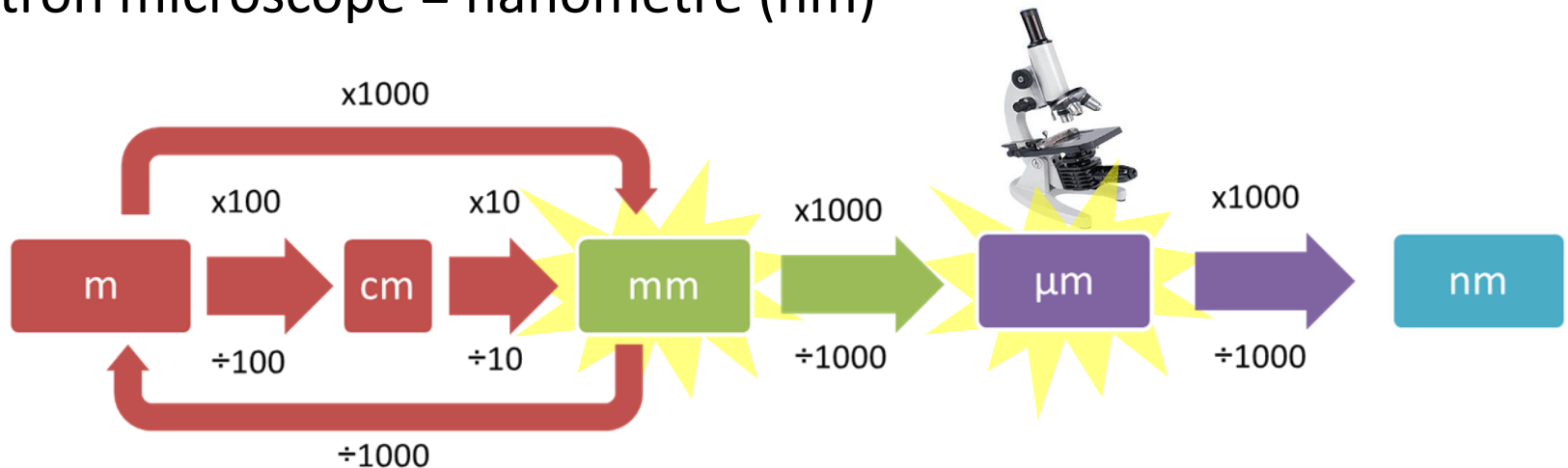
HOW DO WE
MEASURE CELLS?

Units

- SI unit for length → metre (m)

Suitable units for...

- Light microscope = micrometre (μm)**
- Electron microscope = nanometre (nm)



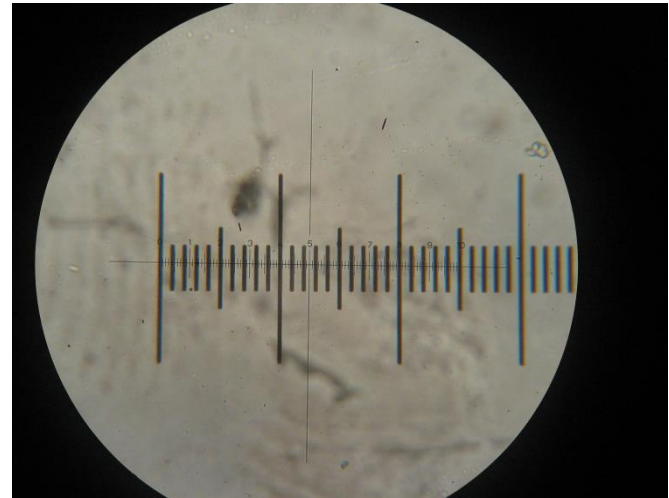
Note:

- Always measure image length in **mm** !!!
- Present the actual diameter of structure in **μm**

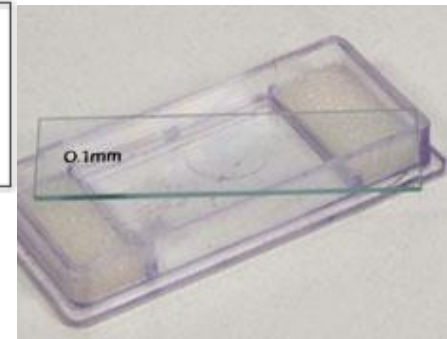
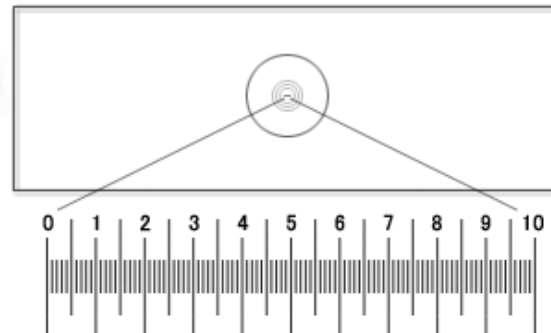
How do we measure cells?



Eyepiece graticule (EPG) is on the eyepiece lens



Stage micrometer is placed on the stage



How do we measure cells?

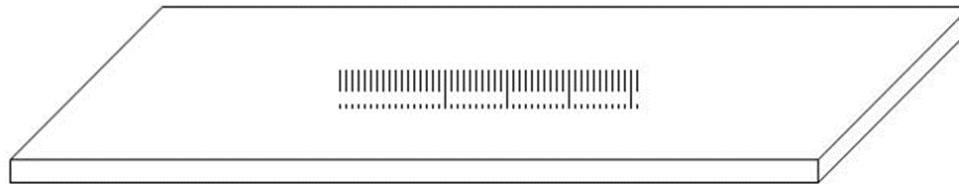
Two components needed:

- **The stage micrometer**

Shows the true value of length

(Usually 10mm in length with 100 small divisions)

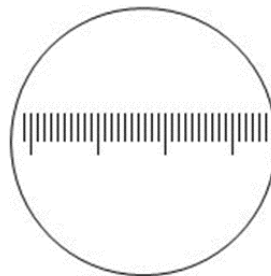
Appears bigger when magnification increases



- **The eyepiece graticule (EPG)**

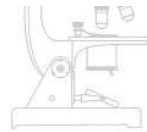
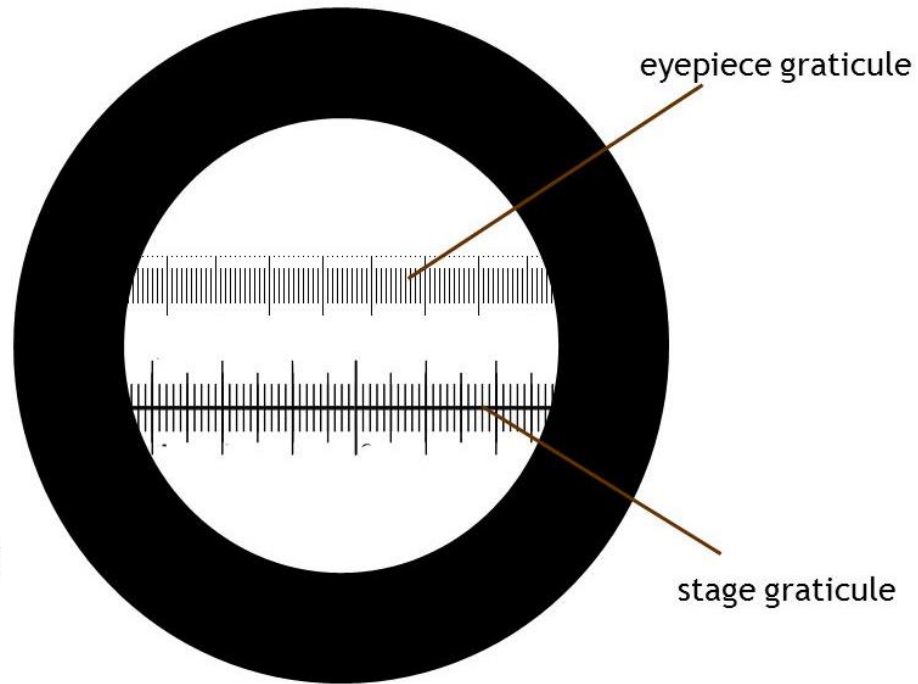
Shows 100 graticule units (100 EPG) which are in arbitrary units

Appears constant no matter the magnification

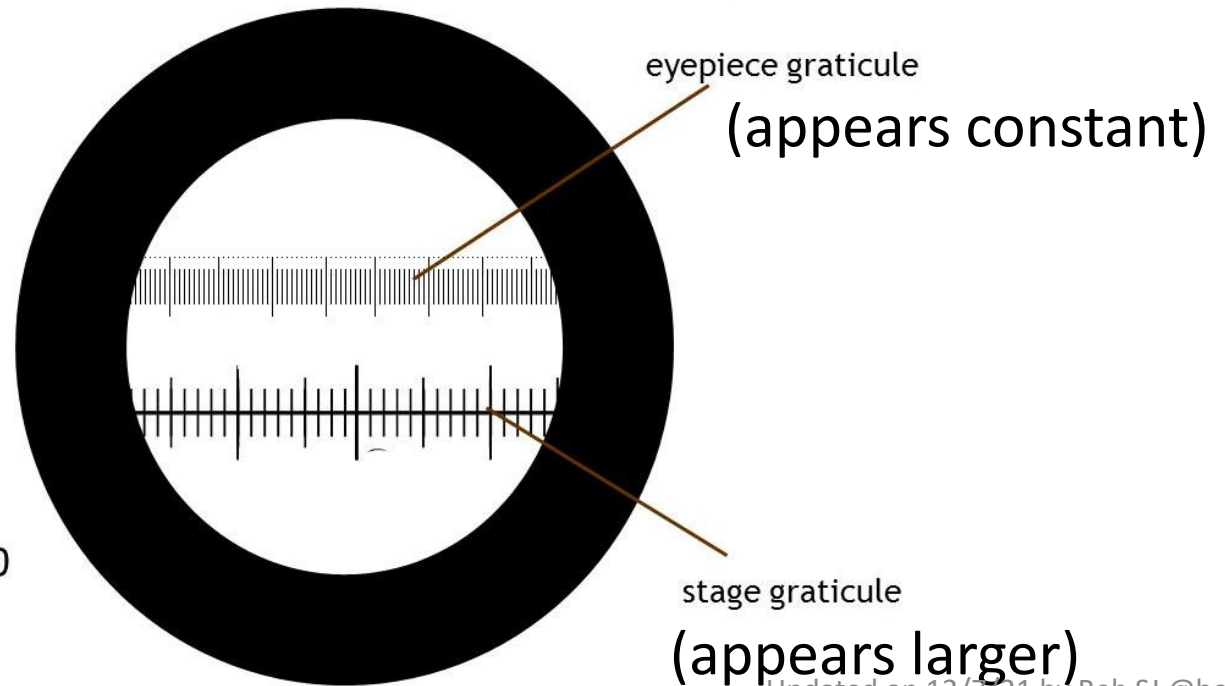




e.g. x100



e.g. x400



How do we measure cells?

Two Steps:

1. Calibrate the EPG with the stage micrometer

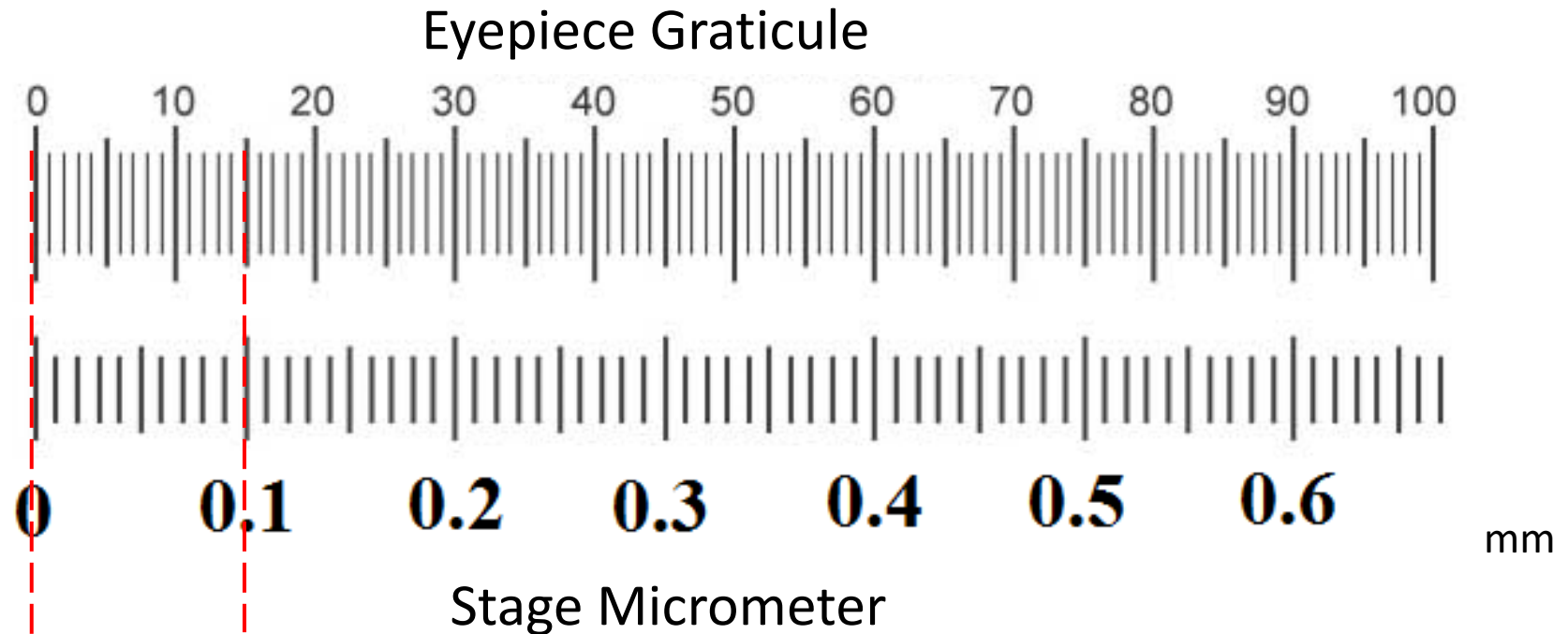
- 1 EPG = ___?___ div = ___?___ μm

2. Use the EPG to measure cell/structure

- 1 cell = ___?___ EPG = ___?___ μm

1. Calibrate the EPG with the stage micrometer

$$1 \text{ EPG} = \text{___?___ div} = \text{___?___ } \mu\text{m}$$

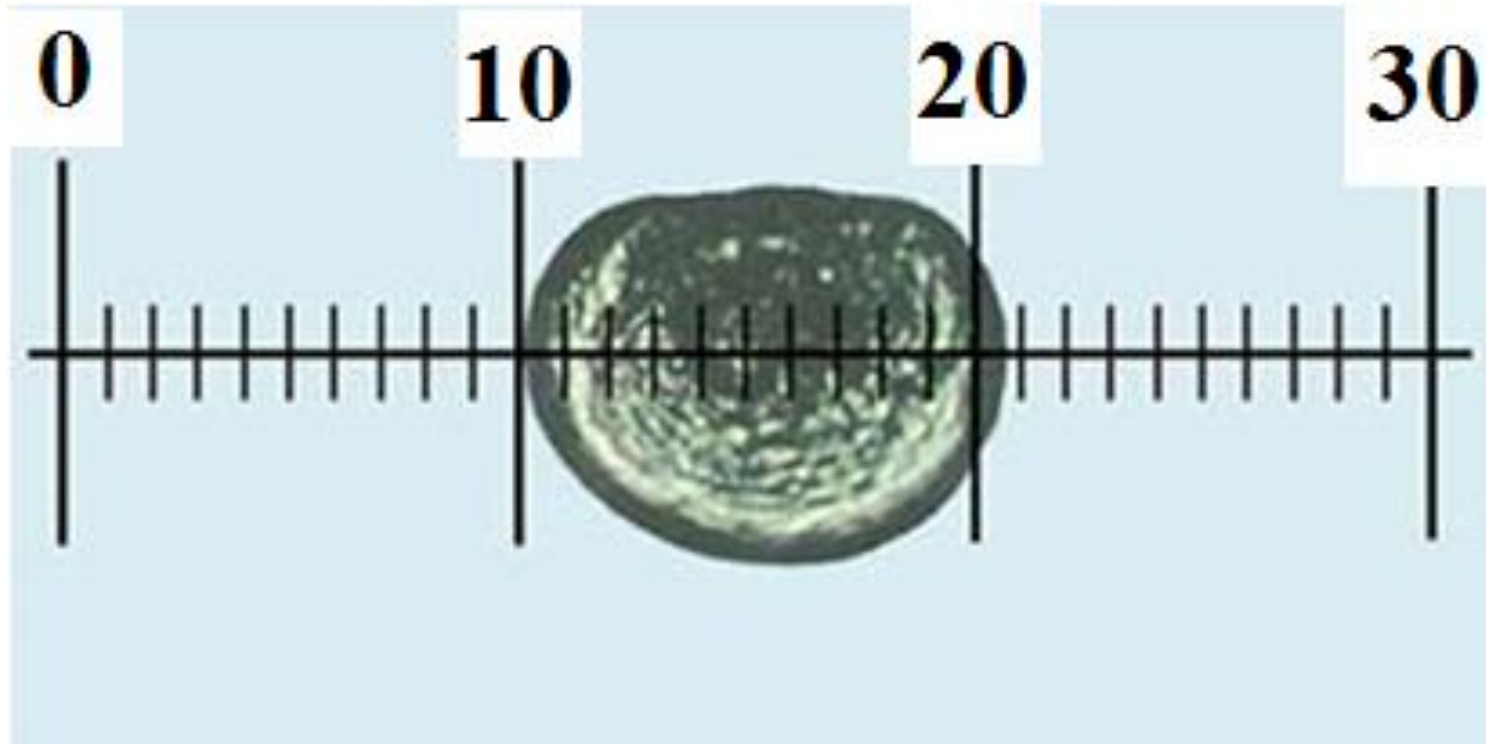


$$15 \text{ EPG} = 10 \text{ div} = 0.1 \text{ mm}$$

$$\begin{aligned} 1 \text{ EPG} &= 0.1 \text{ mm}/15 \\ &= 100 \mu\text{m}/15 \\ &= 6.67 \mu\text{m} \end{aligned}$$

2. Use the EPG to measure cell/structure

1 cell = ___?___ EPG = ___?___ μm



Diameter of cell = 11 EPG

1 EPG = $6.67\mu\text{m}$

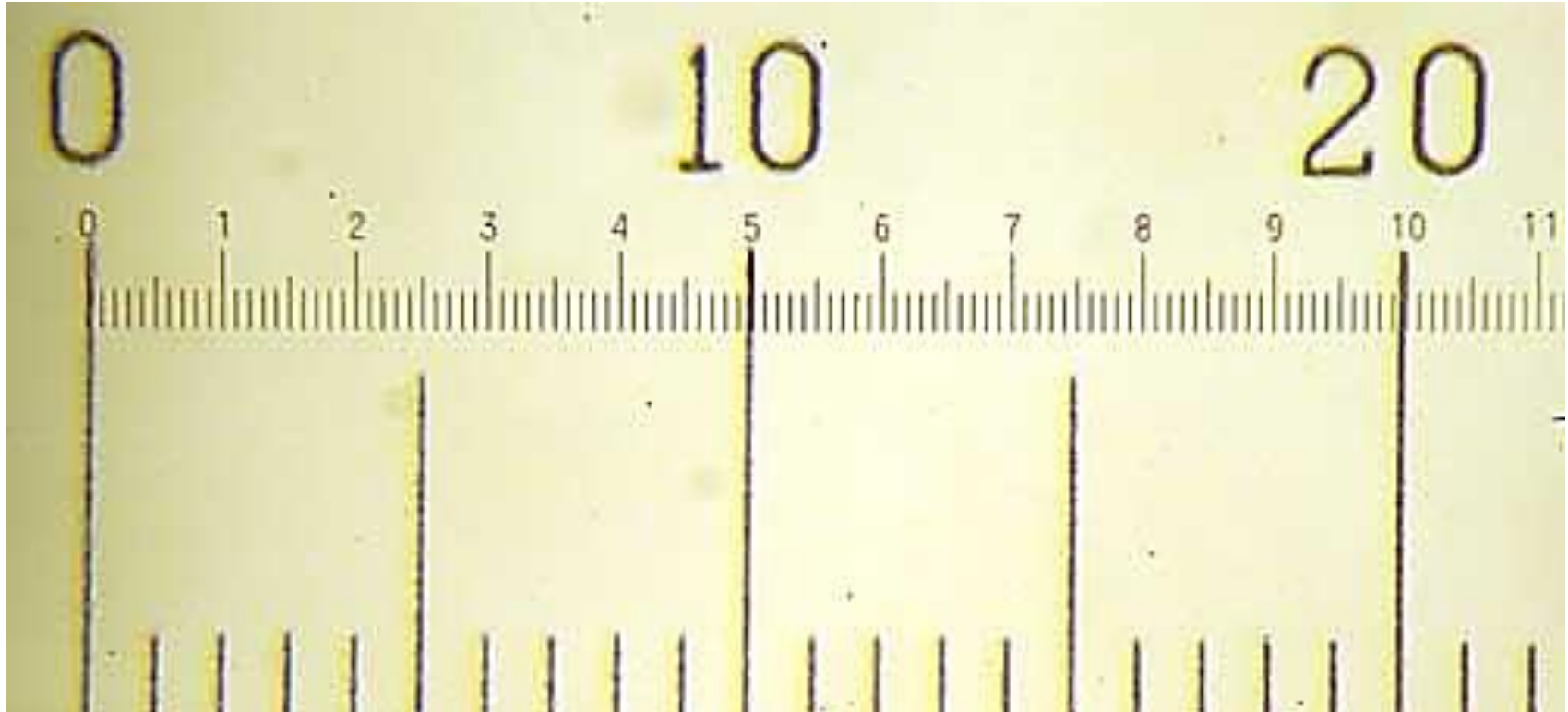
Diameter of cell = $11 \text{ EPG} * 6.67\mu\text{m}$
 $= 73.37 \mu\text{m}$

Now you try!

1. Calibrate the EPG with the stage micrometer

$$1 \text{ EPG} = \_\_\text{?} \_\_\text{div} = \_\_\text{?} \_\_\text{ }\mu\text{m}$$

Q: Given that 100 divisions of the stage micrometer measures 1mm, calibrate the EPG.



Hint 1: the stage micrometer could be magnified under the microscope

Hint 2: 10 EPG is marked 1 here!

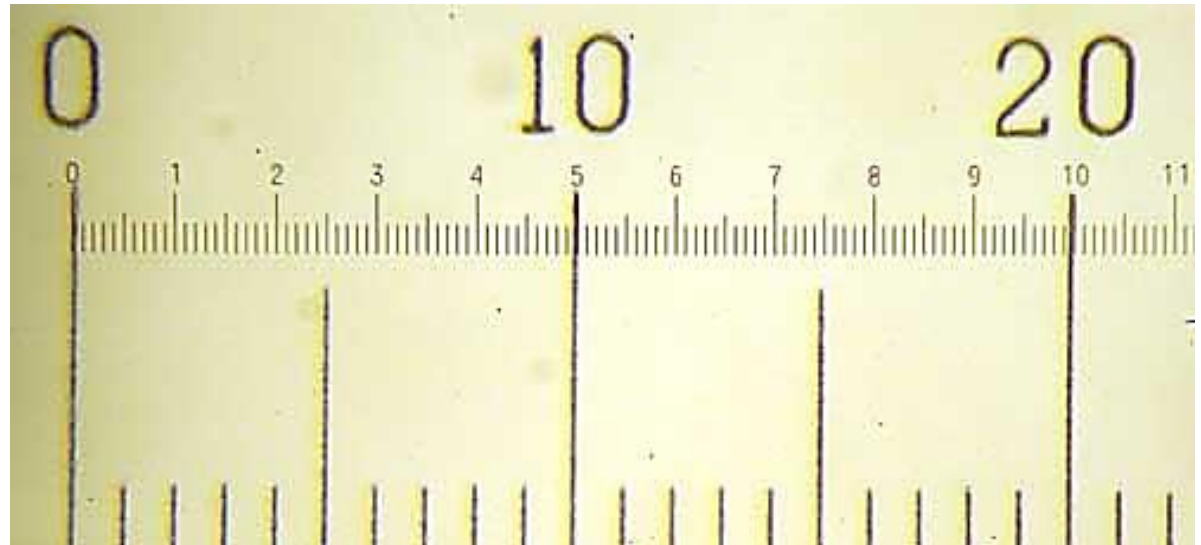
Q: Given that 100 divisions of the stage micrometer measures 1mm, calibrate the EPG.

A:

$$100\text{div} = 1\text{mm}$$

$$1\text{div} = 0.01\text{mm}$$

$$= 10\mu\text{m}$$



$$50 \text{ EPG} = 10\text{div}$$

$$50 \text{ EPG} = 10 * 10\mu\text{m}$$

$$= 100\mu\text{m}$$

$$1 \text{ EPG} = 100\mu\text{m} / 50$$

$$= 2\mu\text{m}$$

Magnification

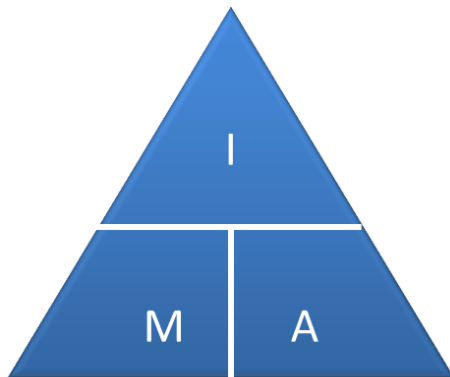


- Number of times an **image** is **enlarged**, compared with the **actual size** of the object
- Formula:

$$M = \frac{I}{A}$$

Remember to convert all measurements to the same units!

Pro tip:



- 1. Convert**
- 2. Substitute**
- 3. Calculate**

Exercise

Q: On an electromicrograph, a mitochondrion measures 36mm in length.

If the magnification of the micrograph is x30,000, what are the actual length of this organelle in μm ?

$$M = \times 30,000$$

$$l = 36\text{mm} = 36 \times 1000 \mu\text{m} = 36000 \mu\text{m}$$

$$A = l / M$$

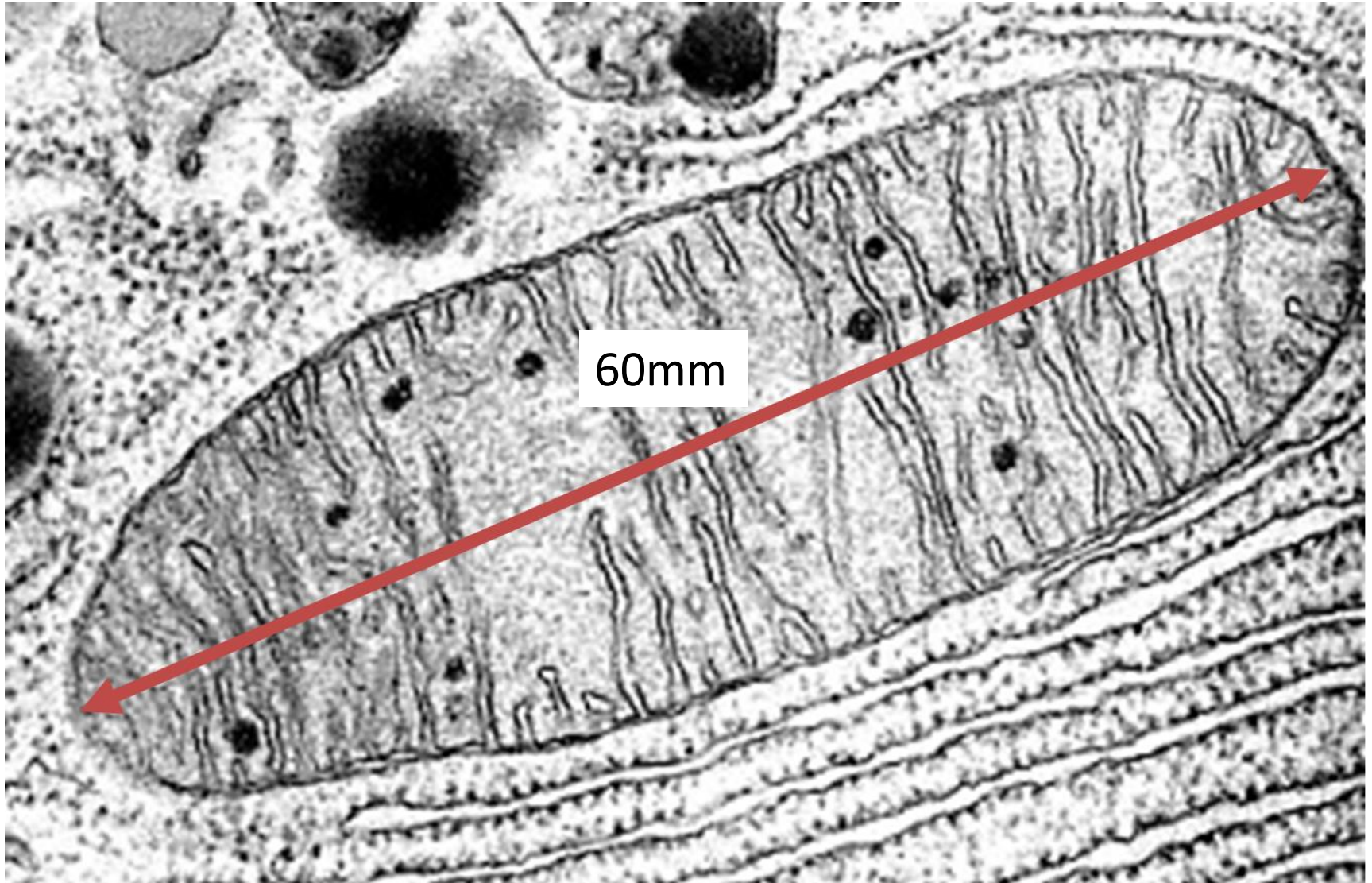
$$= 36000 \mu\text{m} / 30\,000$$

$$= 1.20 \mu\text{m}$$

- 1. Convert**
- 2. Substitute**
- 3. Calculate**

Exercise

Q: Given that the magnification of this electron micrograph is $\times 20,000$, calculate the actual length of this mitochondria.



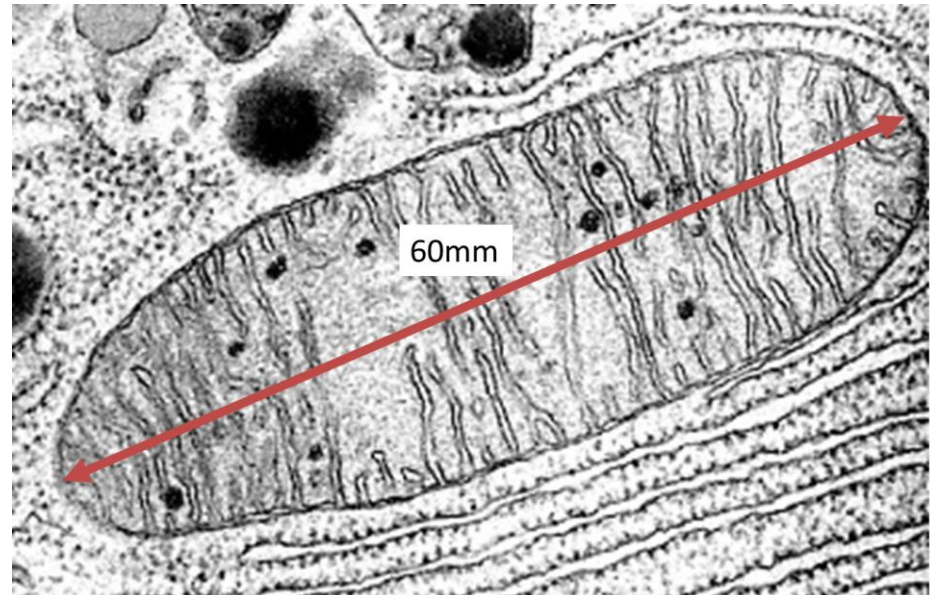
Exercise

Q: Given that the magnification of this electron micrograph is x200,000, calculate the actual length of this mitochondria.

$$M = \times 20,000$$

$$l = 60\text{mm} = 60 * 1000 \mu\text{m} \\ = 60,000 \mu\text{m}$$

$$A = l / M \\ = 60,000 \mu\text{m} / 20000 \\ = 3 \mu\text{m}$$



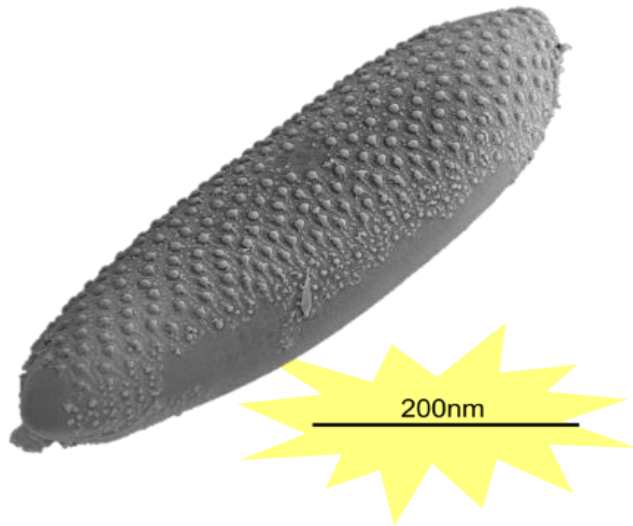
- 1. Convert**
- 2. Substitute**
- 3. Calculate**

Exercise

Q: This is a micrograph taken by an electron microscope of the egg of an *Aedes* mosquito.

What is the magnification of this image?

You need to physically measure the scale bar!

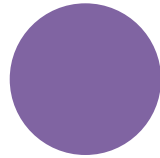
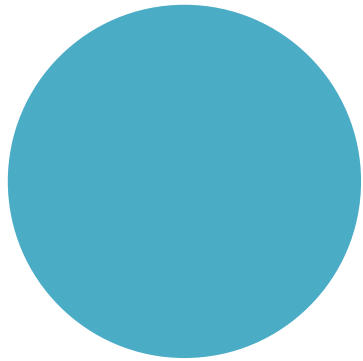


$$A = 200\text{nm}$$

$$\begin{aligned} I \text{ (measured)} &= 13\text{mm} = (13 \times 1000 \times 1000)\text{nm} \\ &= 13000000\text{nm} \end{aligned}$$

$$\begin{aligned} M &= I / A \\ &= 13000000 / 200 \\ &= \times 65,000 \end{aligned}$$

Magnification should always have a 'x' in front and expressed in whole numbers



CELL STRUCTURE AND FUNCTION

Cell Structure and Function

Organelles

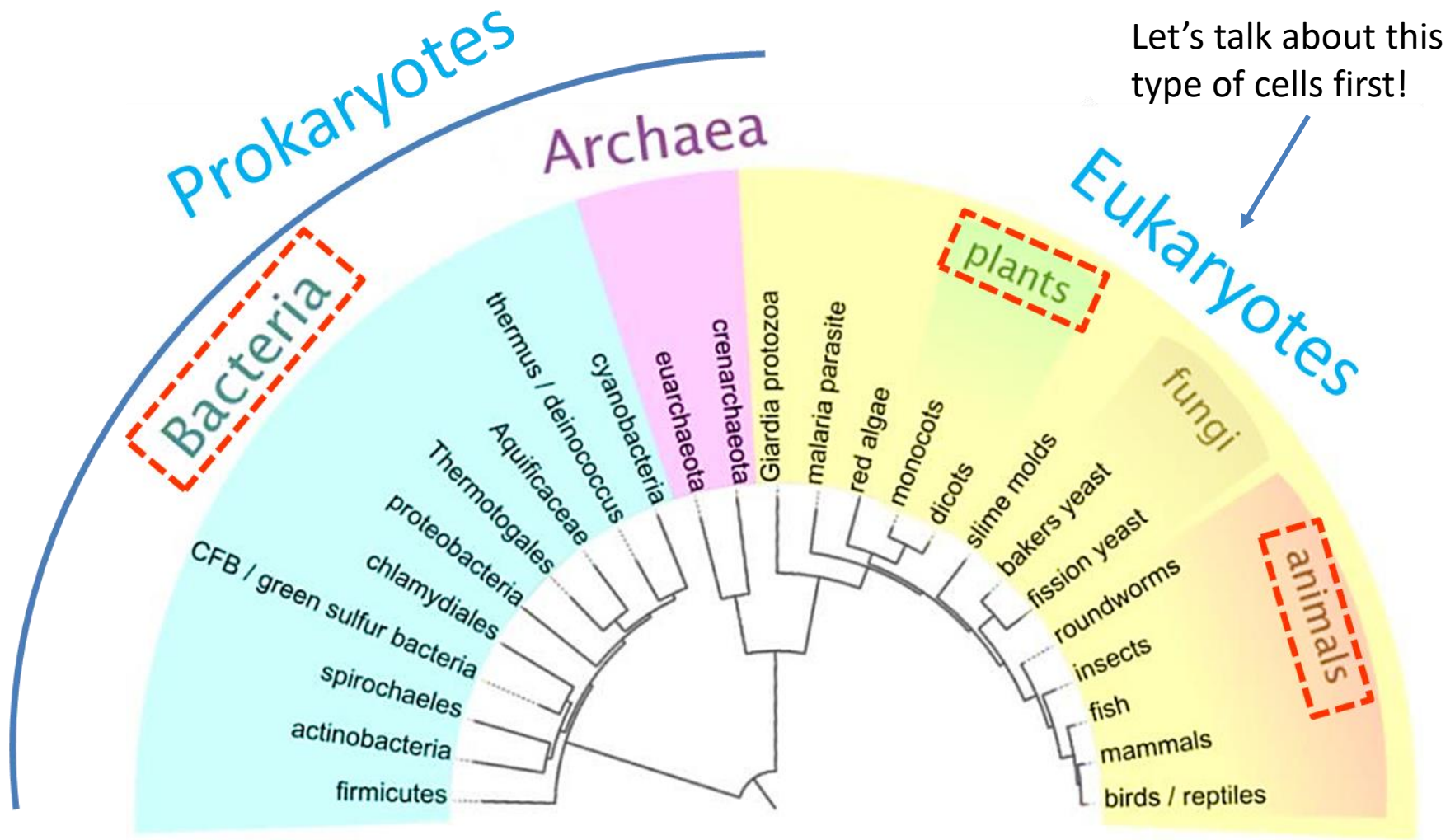
- Functionally and structurally distinct part of a cell
- Surrounded by membranes
- For compartmentalization
 - So that reactions do not interfere with each other
 - Each has separate, specific function

Ultrastructure of cells

- Not necessarily surrounded by membranes
- Detailed structures of a cell
- Only can be seen under an electron microscope



Two types of cells: Prokaryotes vs Eukaryotes on the Tree of Life



List of Eukaryotic Cell Structures

Plant + Animal Cells included!

You need to:

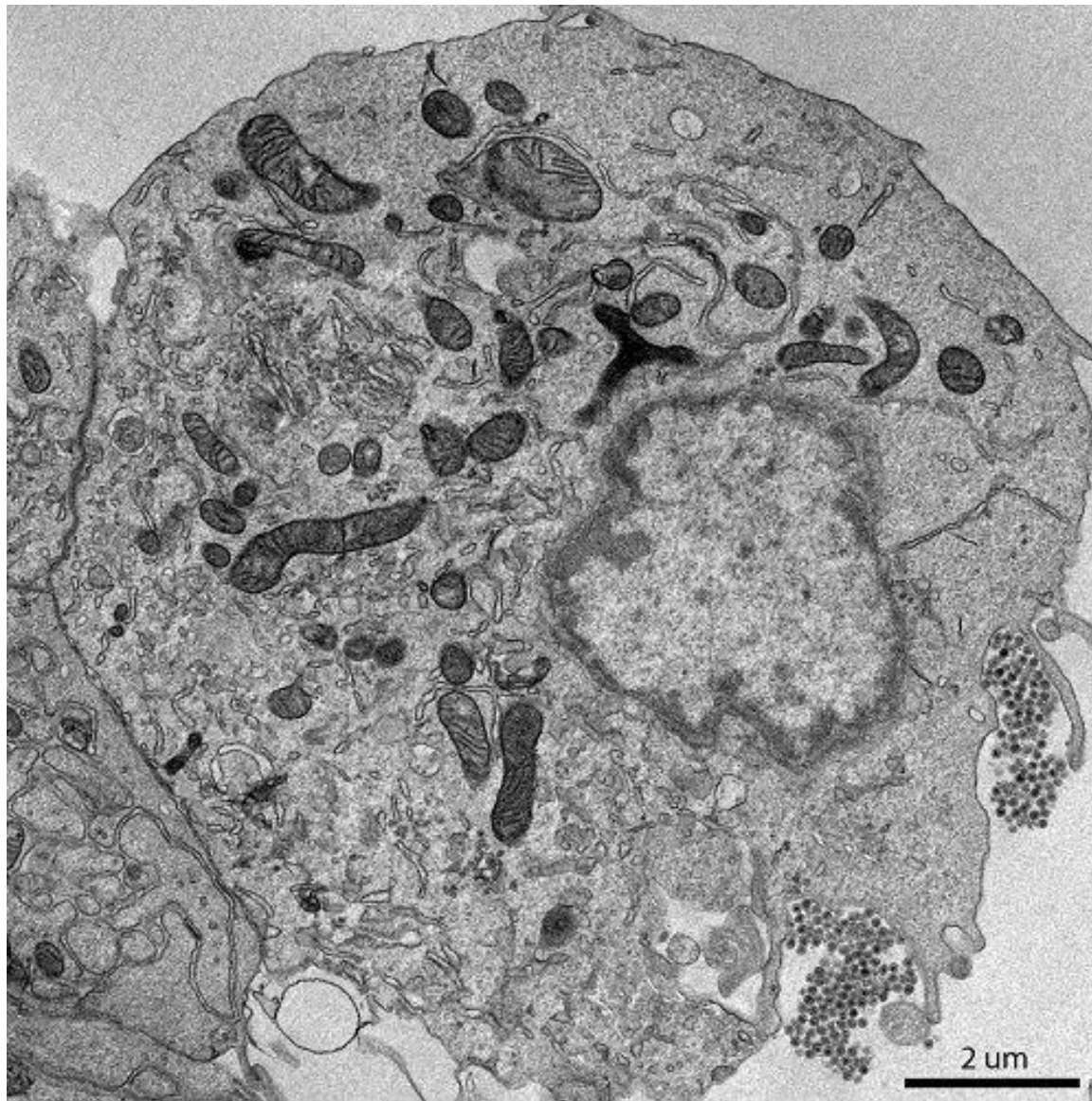
1) Name it

2) Recognise it

3) Know its function

1. Cell surface membrane
2. Nucleus, nuclear envelope and nucleolus
3. Ribosomes
4. RER
5. SER
6. Golgi body
7. Lysosomes
8. Mitochondria

9. Chloroplast
10. Cell wall
11. Plasmodesmata
12. Vacuole and tonoplast
13. Centrioles
14. Microtubules
15. Cilia
16. Microvilli



Electromicrograph of a cell

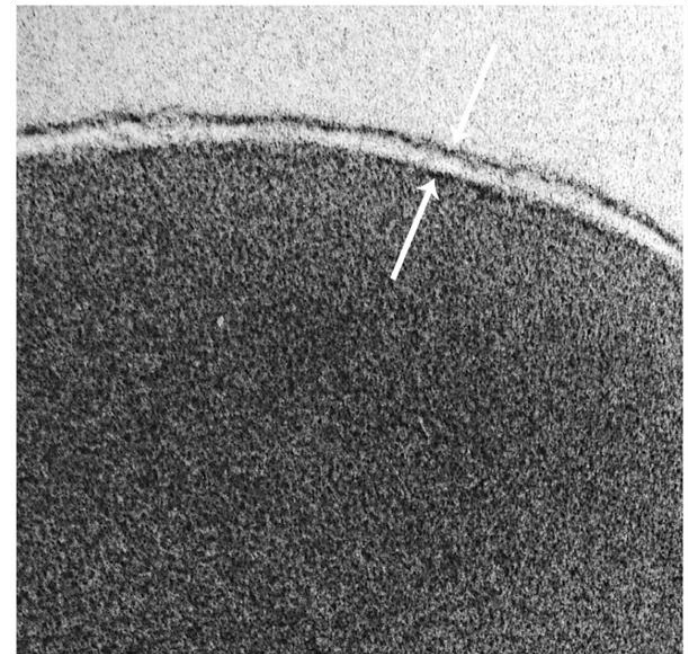
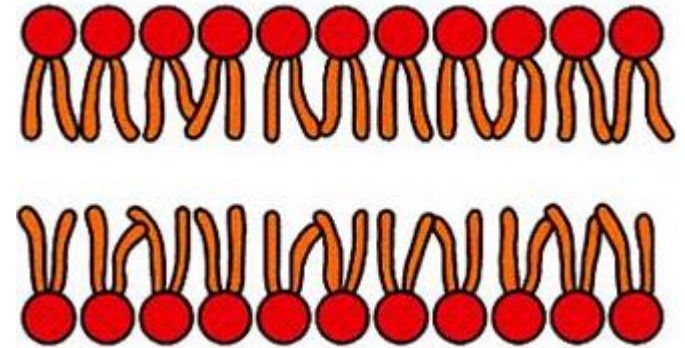
You should learn to identify the main organelles visible here!

1. Cell Surface Membrane

- Plasma membrane
- **~7 nm thick**
- Seen as three layers at x100,000
→ Trilaminar appearance
- **Partially permeable**
- Made of **phospholipid bilayer**

Function:

Controls movement of substances into and out of the cell



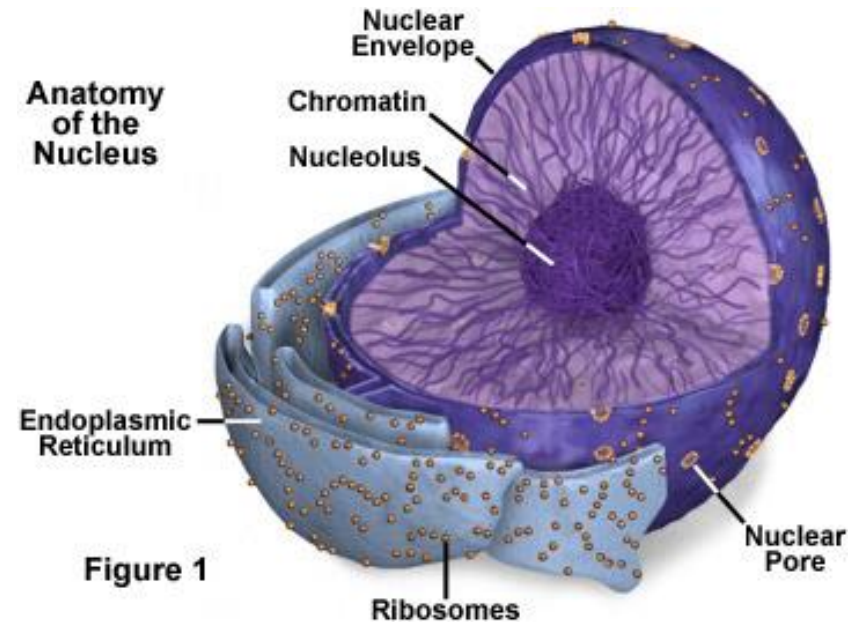
50 nm

2. Nucleus

- Largest organelle!
- **Has double membranes**

General Function:

- **Contains genetic information for the synthesis of proteins**
- Site of transcription of genes and production of mRNA
- DNA is protected from degradation by enzymes



Components:

1. Nuclear envelope

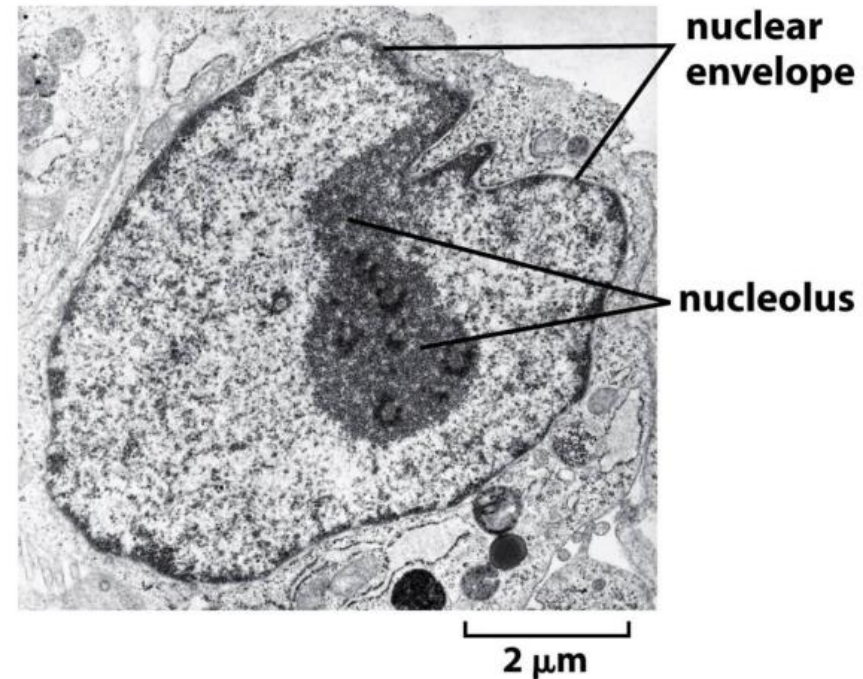
- Attached to ER
- **2 membranes**
- Have nuclear pores
- **Function: Controls movement of substances between nucleus and cytoplasm**

2. Nucleolus

- Densest region
- **Function: Site of ribosomal RNA (rRNA) synthesis**
→ Site of ribosome assembly

3. Chromatin = DNA and its associated proteins

2. Nucleus



3. Ribosomes

- Smallest organelle!
- Not bound by a membrane
- Made of **rRNA**, that is synthesized in nucleolus + some protein
- Has 2 subunits

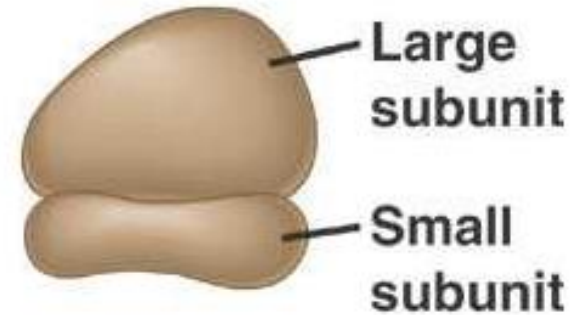
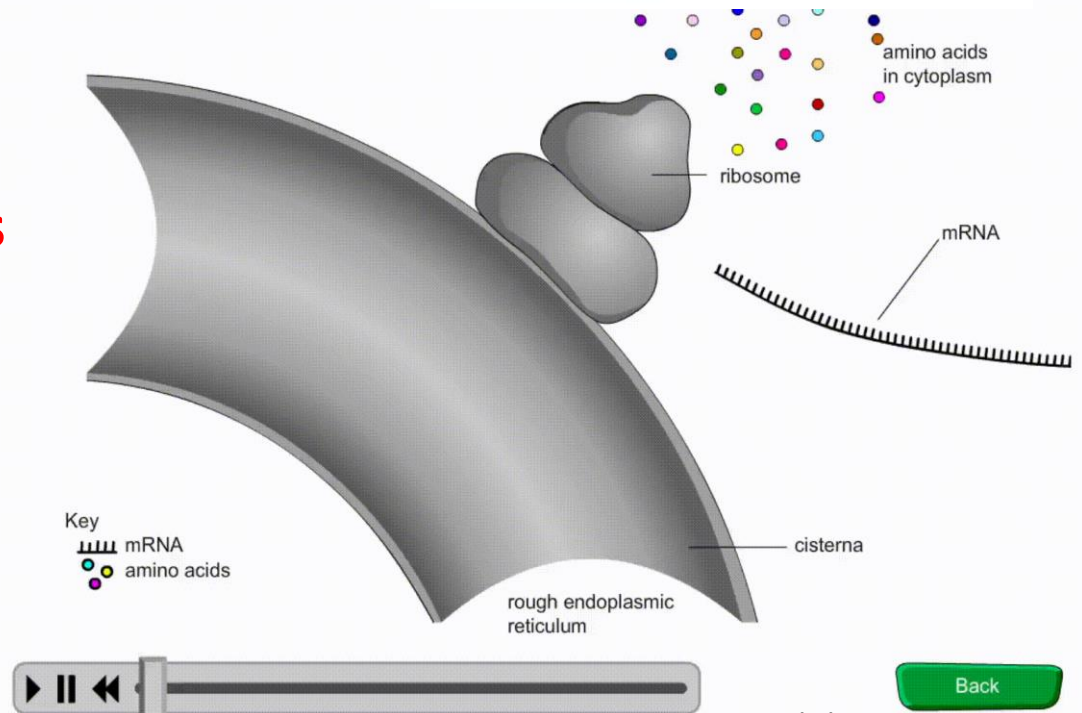


Diagram of a ribosome

Function:

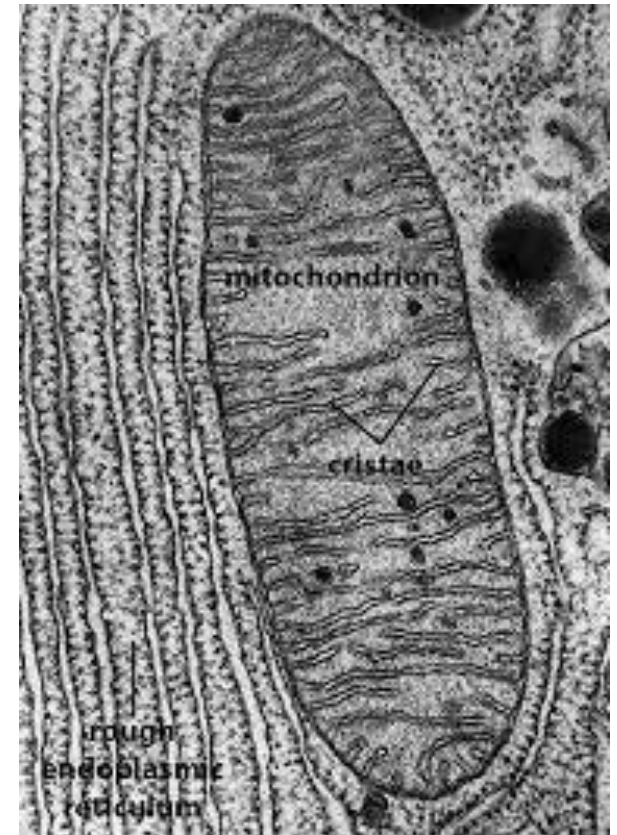
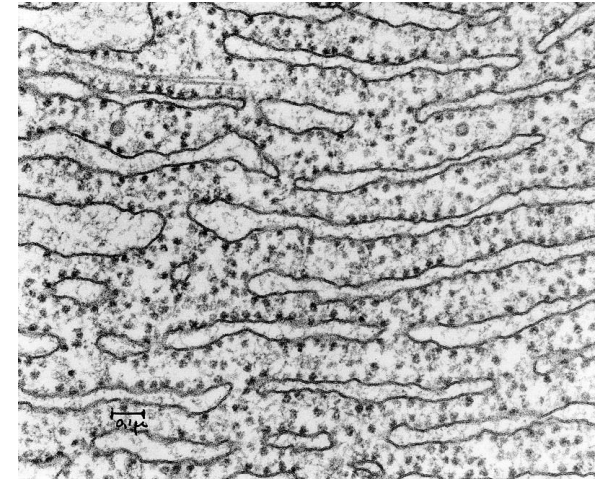
- **Site of protein synthesis**



3. Ribosomes

Two types:

1. **80S** ribosomes are
 - **25nm** (*rmb this!*)
 - Larger
 - Found in **cytoplasm and RER** of all **eukaryotes**
2. **70S** ribosomes are
 - 18nm
 - Smaller
 - Found in **mitochondria and chloroplasts** of eukaryotes
 - Found in all **prokaryotes**



4. Rough Endoplasmic Reticulum

- Extensive, connected system of membranes
- Made of cisternae (flattened membrane sacs)
- **Continuous with the nuclear envelope**
- Running through the cytoplasm
- 80S ribosomes are attached



Functions:

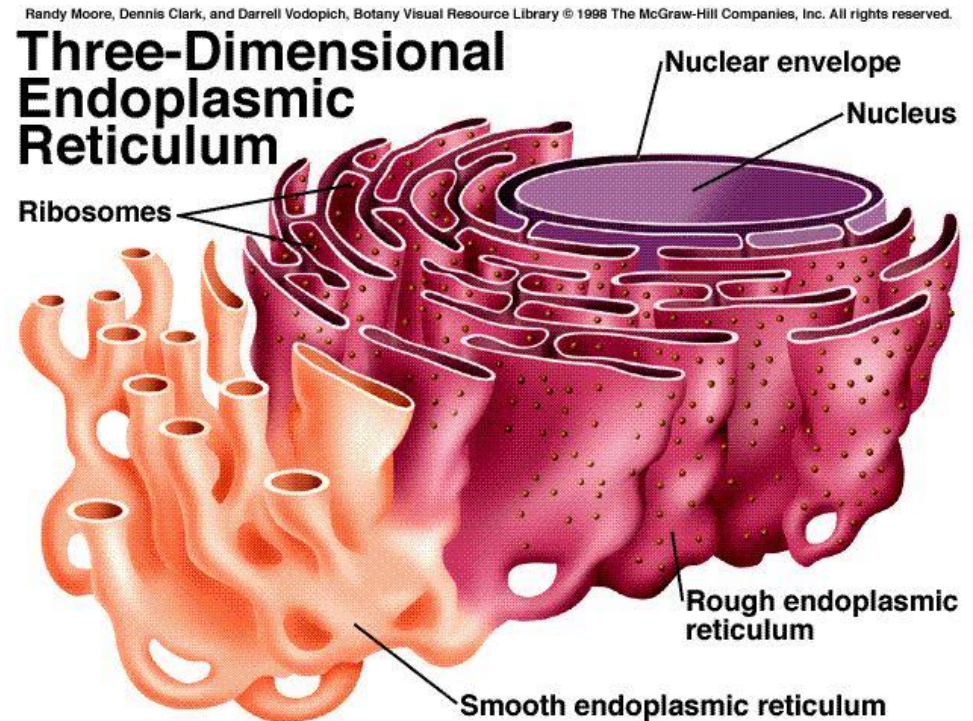
- Site of protein **synthesis**,
- protein **modification**
e.g. protein folding
e.g. glycosylation = addition of carbohydrate chains to protein
- protein **transport** to Golgi

5. Smooth Endoplasmic Reticulum

- ER without ribosomes

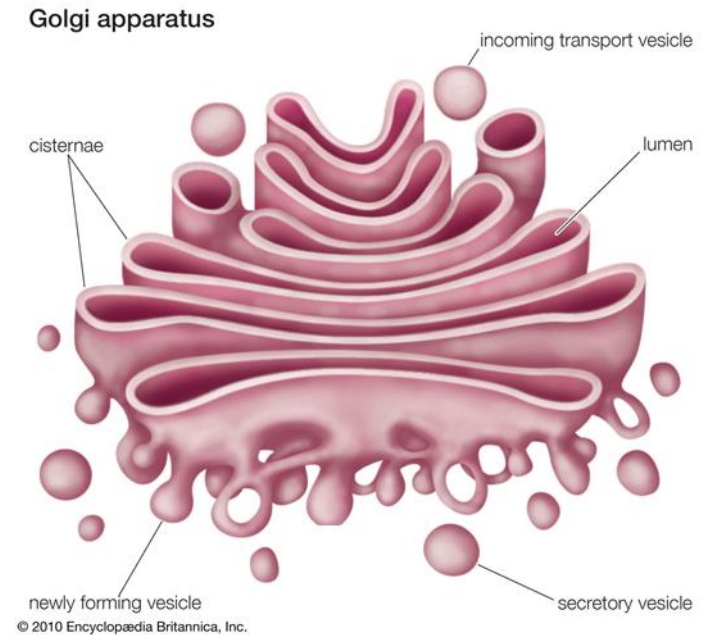
Function:

- **Site of lipid and steroid synthesis**
e.g. cholesterol, steroid hormones



6. Golgi body

- Golgi apparatus / complex
- Made of cisternae
- Have layered appearance
- No connection between members
- Not continuous with nuclear envelope



- Swellings at end of sacs for vesicle formation
 - Constantly being formed and broken down
- **Being formed by:** Transport vesicles from RER on cis face
- **Broken down to form:** Secretory vesicles and lysosomes on trans face

6. Golgi body

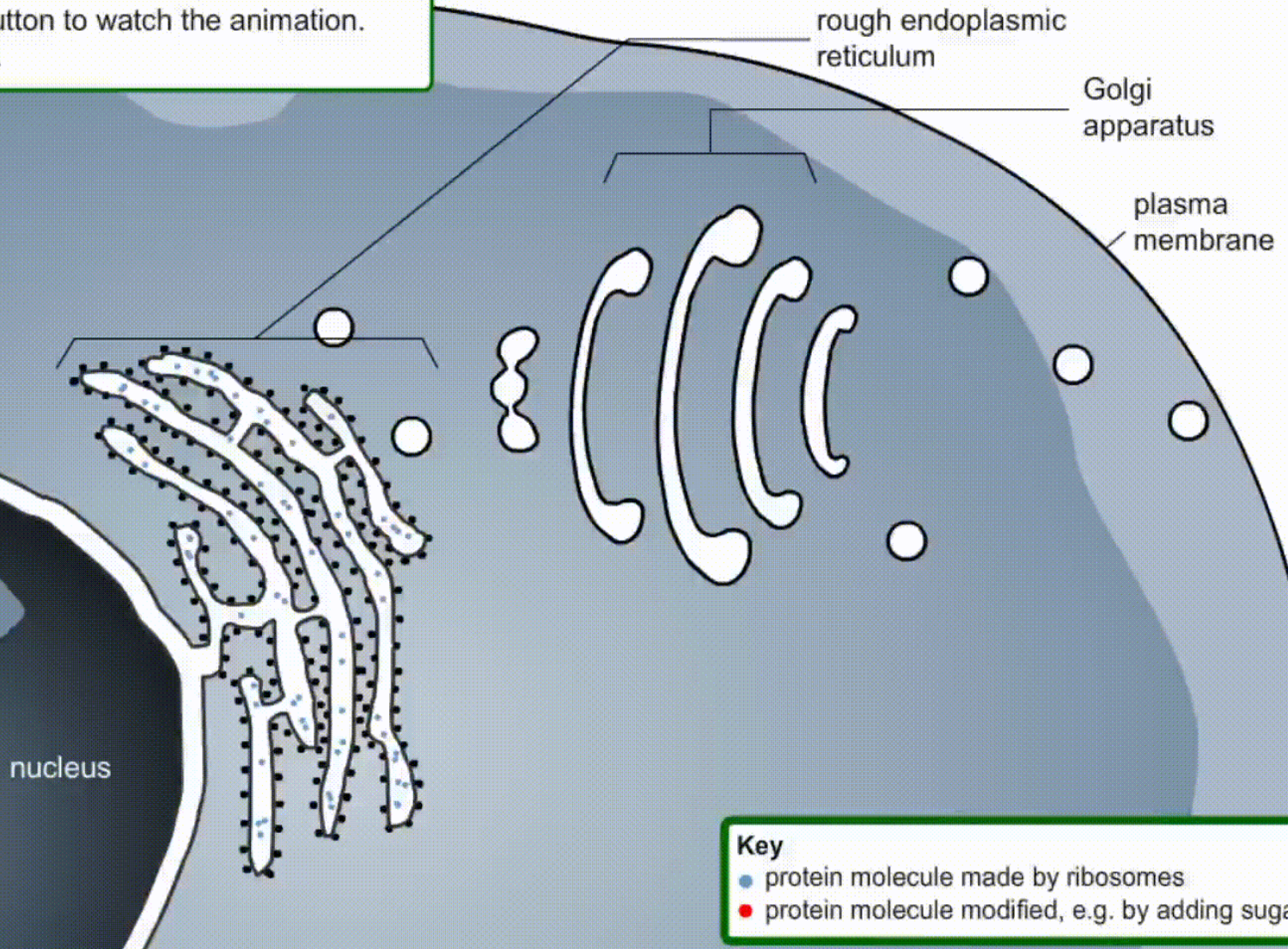
Functions:

- **Modification** of proteins and lipid
E.g. glycosylation
phosphorylation = addition of phosphate gp to proteins
cutting / folding proteins
- **Packaging** molecules into vesicles for transport
- Formation of **secretory vesicles** for release of protein out of the cell
- Formation of **lysosomes**



Production and Secretion of Proteins

Click the **Play** button to watch the animation.
Then click **More**.

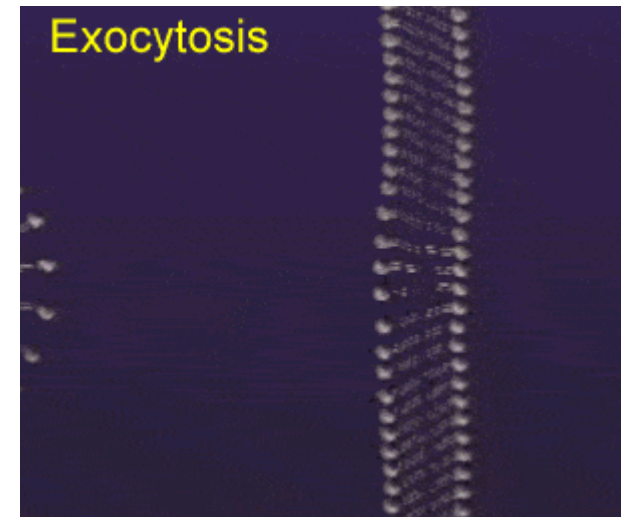
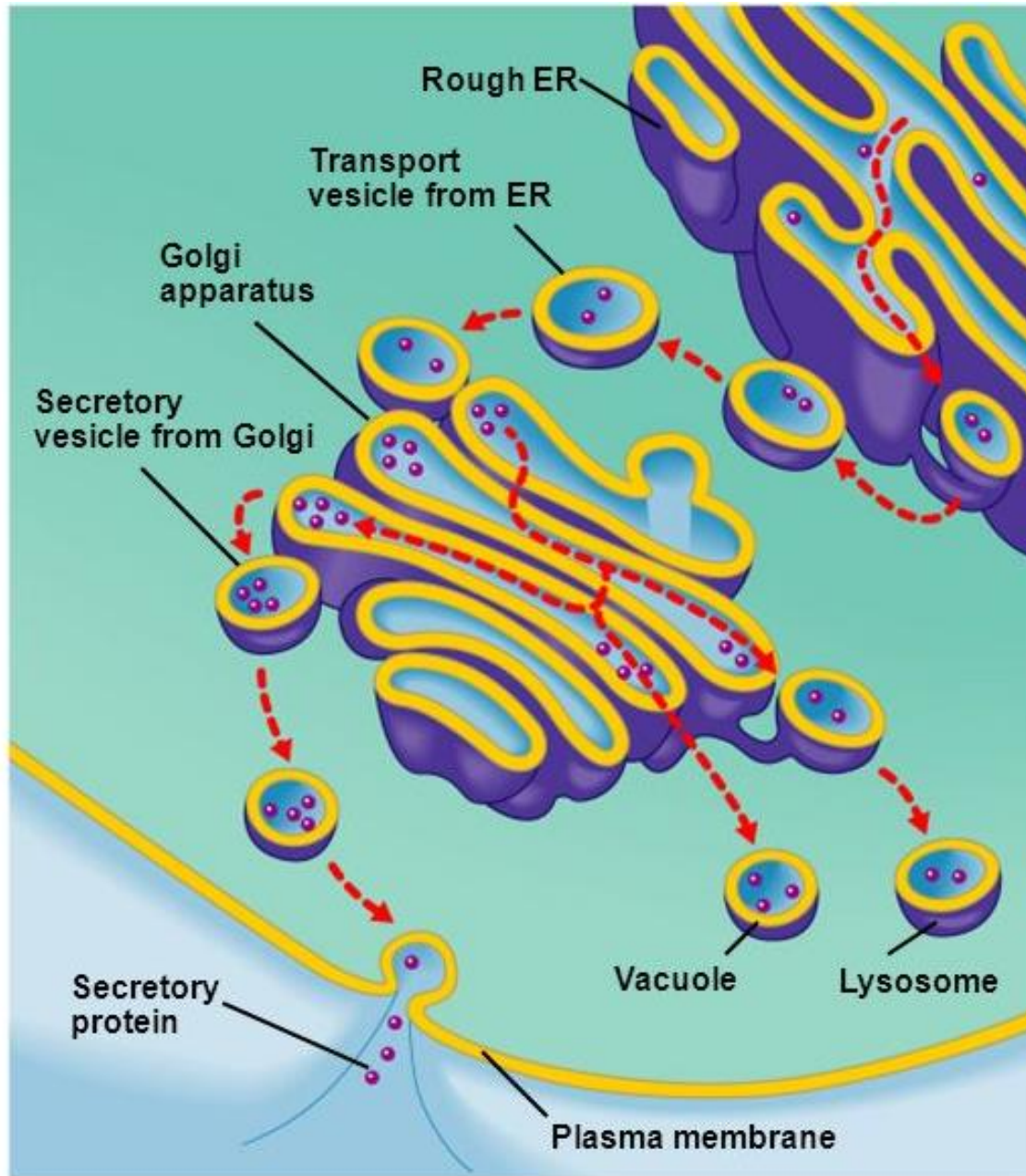


Play

Pause

More

Production and Secretion of Proteins



Production and Secretion of Proteins

List the cell structures involved in sequence:



Steps:

1. Synthesis of protein at **ribosome / RER**
2. **Transport vesicle** buds off **RER** and fuses with **Golgi body**
3. Modification of protein at **Golgi body**
4. Separation of a **secretory vesicle** from the **Golgi body**
5. Fusion of the vesicle with the **cell surface membrane**
6. Contents released / secretion of protein by exocytosis

Process also works to embed a protein at the cell membrane.

Exercise

[CIE, June 2013, P13, Q5]

When mucus is secreted from a goblet cell in the trachea, these events take place.

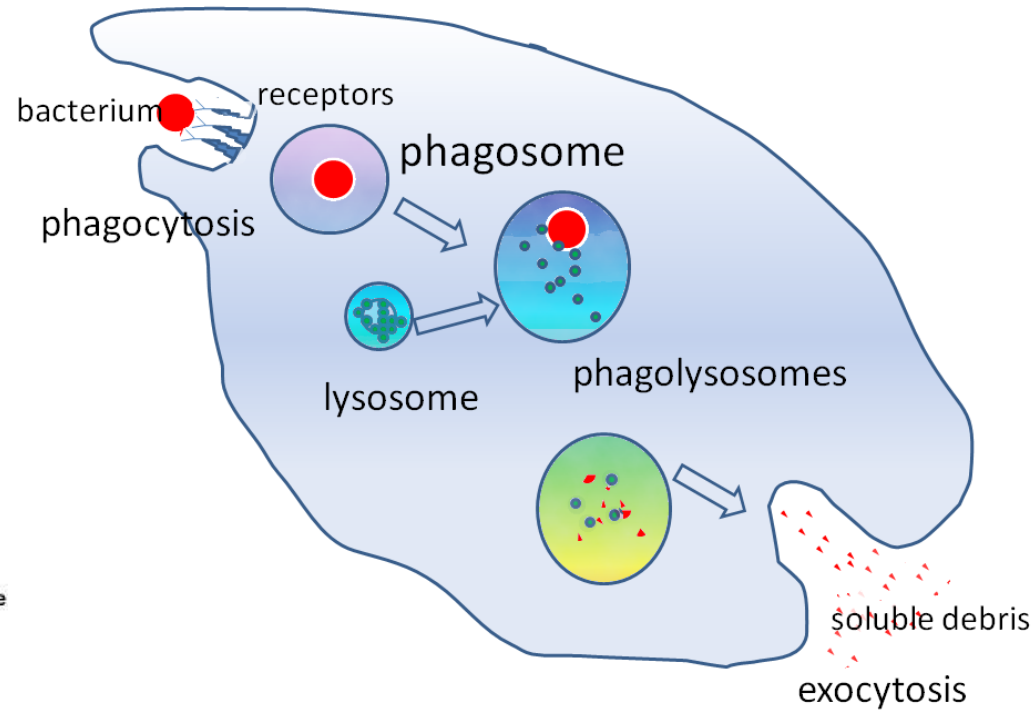
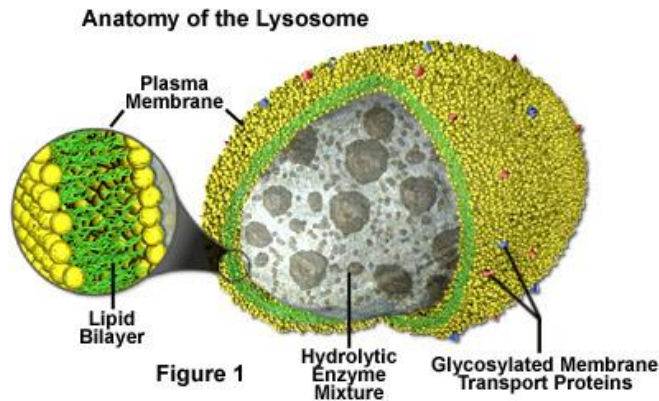
1. addition of carbohydrate to protein
2. fusion of the vesicle with the plasma membrane
3. secretion of a glycoprotein
4. separation of a vesicle from the Golgi apparatus

What is the sequence in which these events take place?

A: $1 \rightarrow 4 \rightarrow 2 \rightarrow 3$

7. Lysosomes

- Very, very small
- Spherical, small sacs



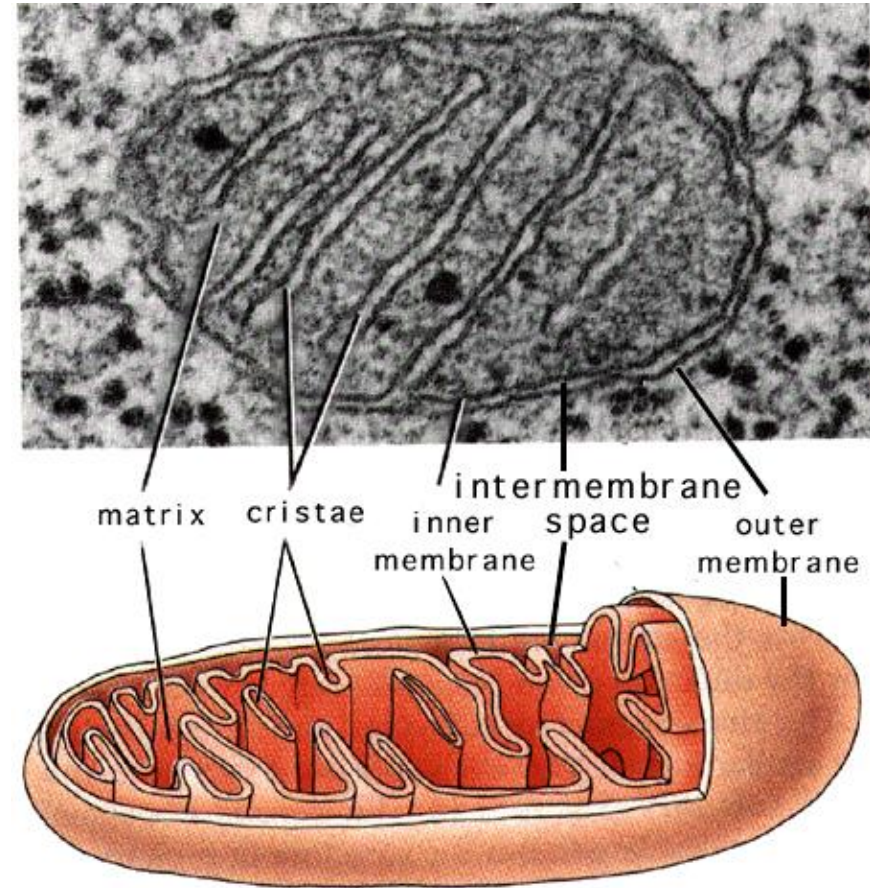
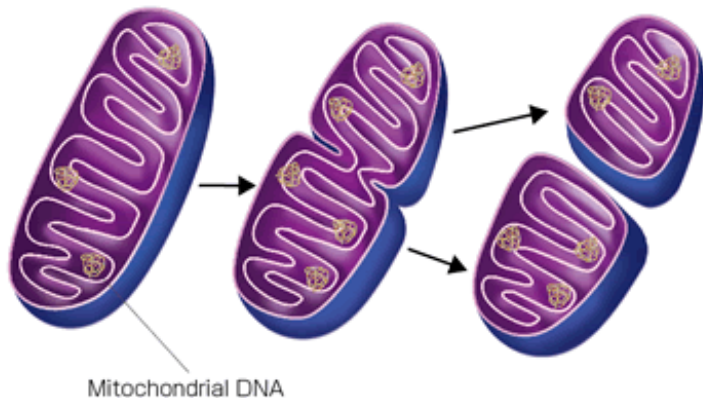
Function:

Contains **hydrolytic enzymes / lysozymes**

- **Breakdown unwanted structures** via hydrolysis in an acidic enviro
- Worn out organelles or dead cells
- In WBC, lysozymes digest bacteria

8. Mitochondria

- Relatively large organelle
 - **Has double membranes**
 - **Cristae** = folded inner membrane
 - **Matrix** = interior solution
 - Contain **70S ribosomes and small circular DNA**
 - Divide by binary fission
- Have prokaryotic origin



8. Mitochondria

Functions:

- Site of aerobic respiration
- synthesize ATP/produce energy in the form of ATP
- release energy



Glucose + Oxygen → Carbon Dioxide + Water + ATP



Please DO NOT write

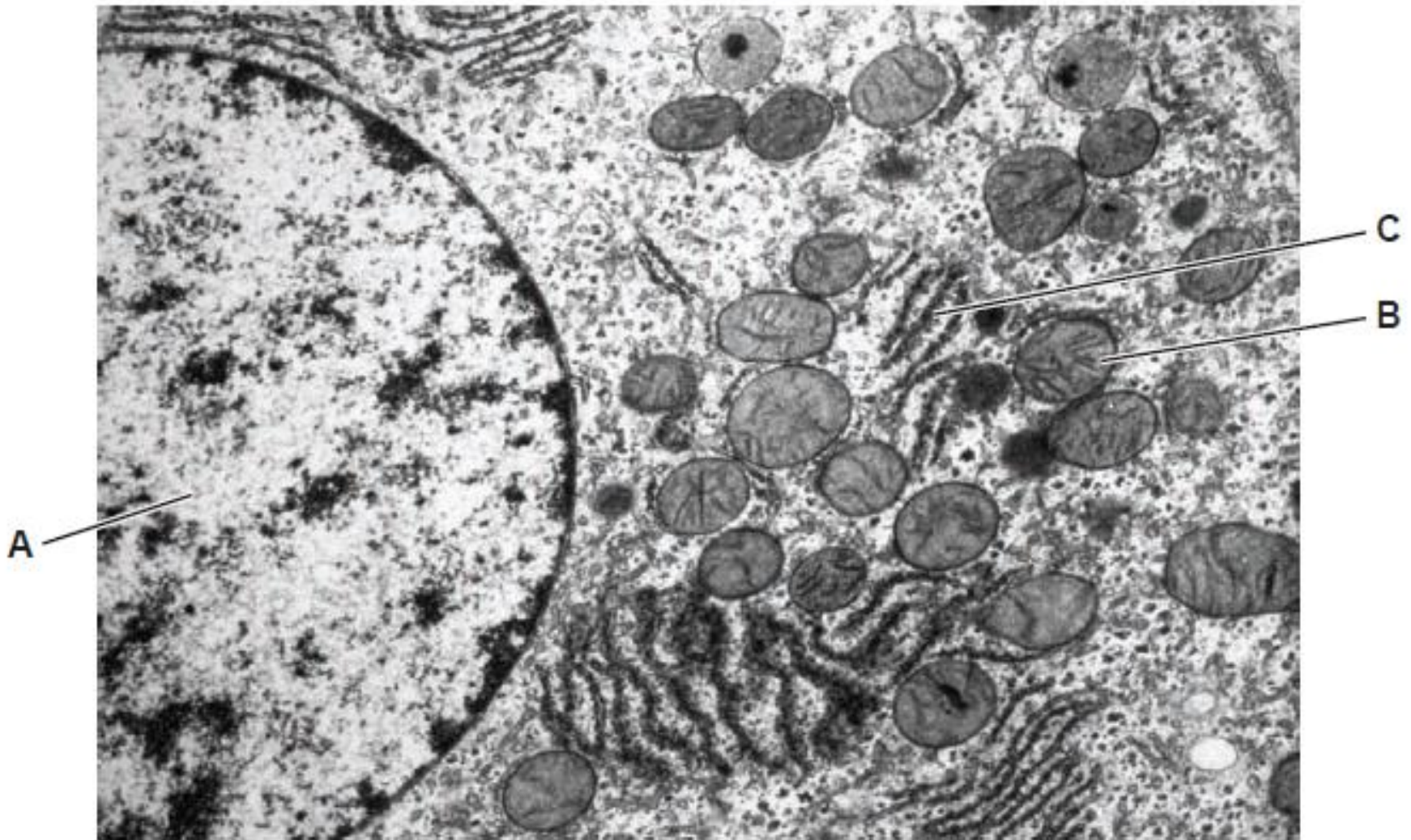
“Mitochondria produces energy”

“Mitochondria is the powerhouse of the cell”

∴

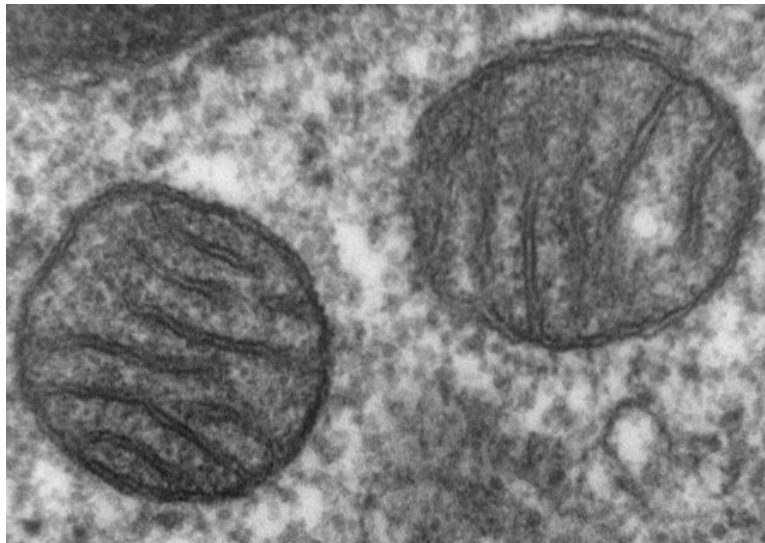
8. Mitochondria

Label the following electron micrograph of an animal cell.



6 μm

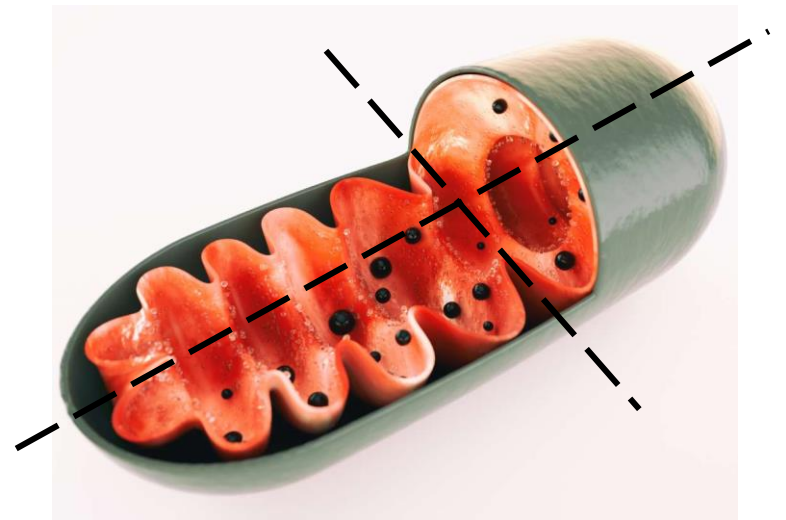
8. Mitochondria



50 nm 08LungTEM 1/7/0 REMF

Q: Why are these mitochondria shaped so differently?

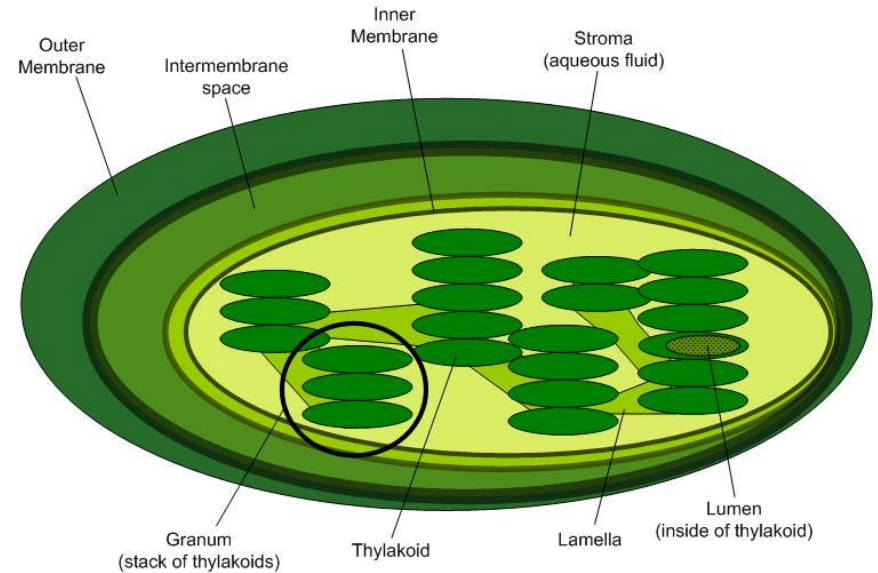
A:



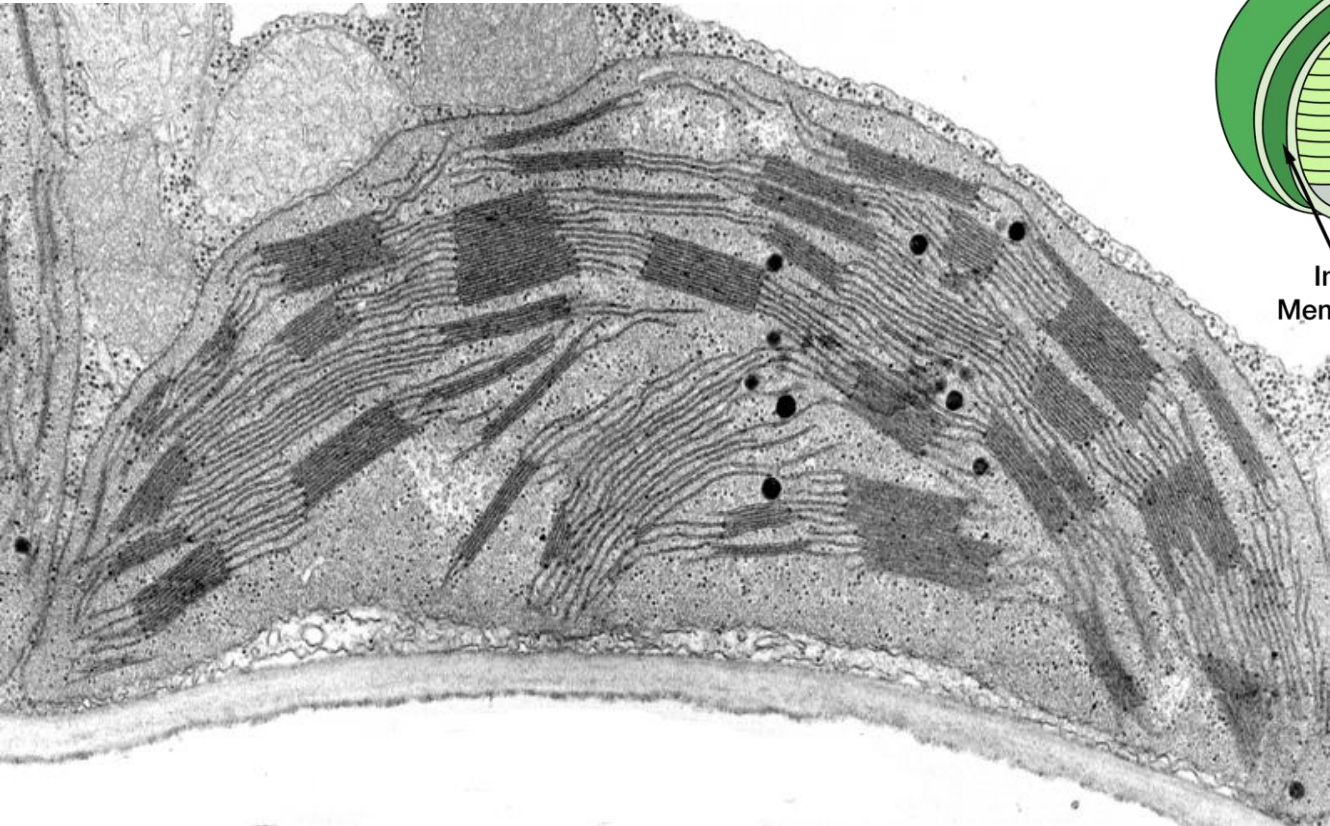
One is a longitudinal cross section and the other is a transverse cross section!
Also shape may sometimes vary.

9. Chloroplasts

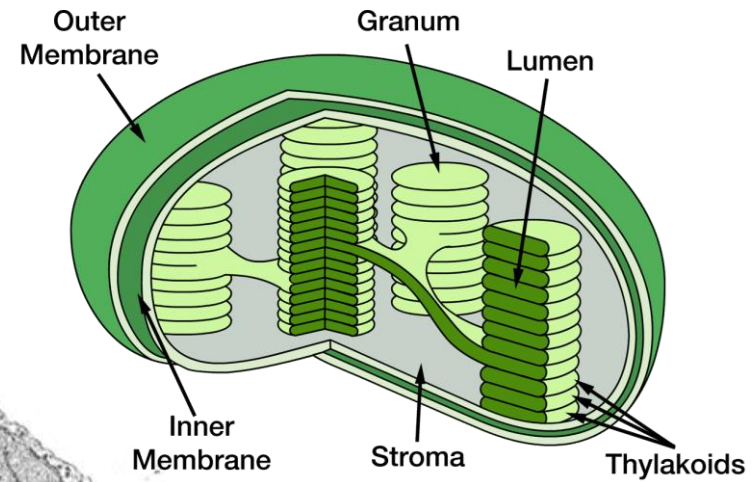
- Relatively large organelle
- Oval shaped
- **Two membranes**
- Contain **chlorophyll**
- **Thylakoid** = flattened membrane sacs
- **Grana** = thylakoid stacks
- **Stroma** = interior solution
- Contains **70S ribosomes, small circular DNA** and starch grains
- Divide by binary fission
- Have prokaryotic origin



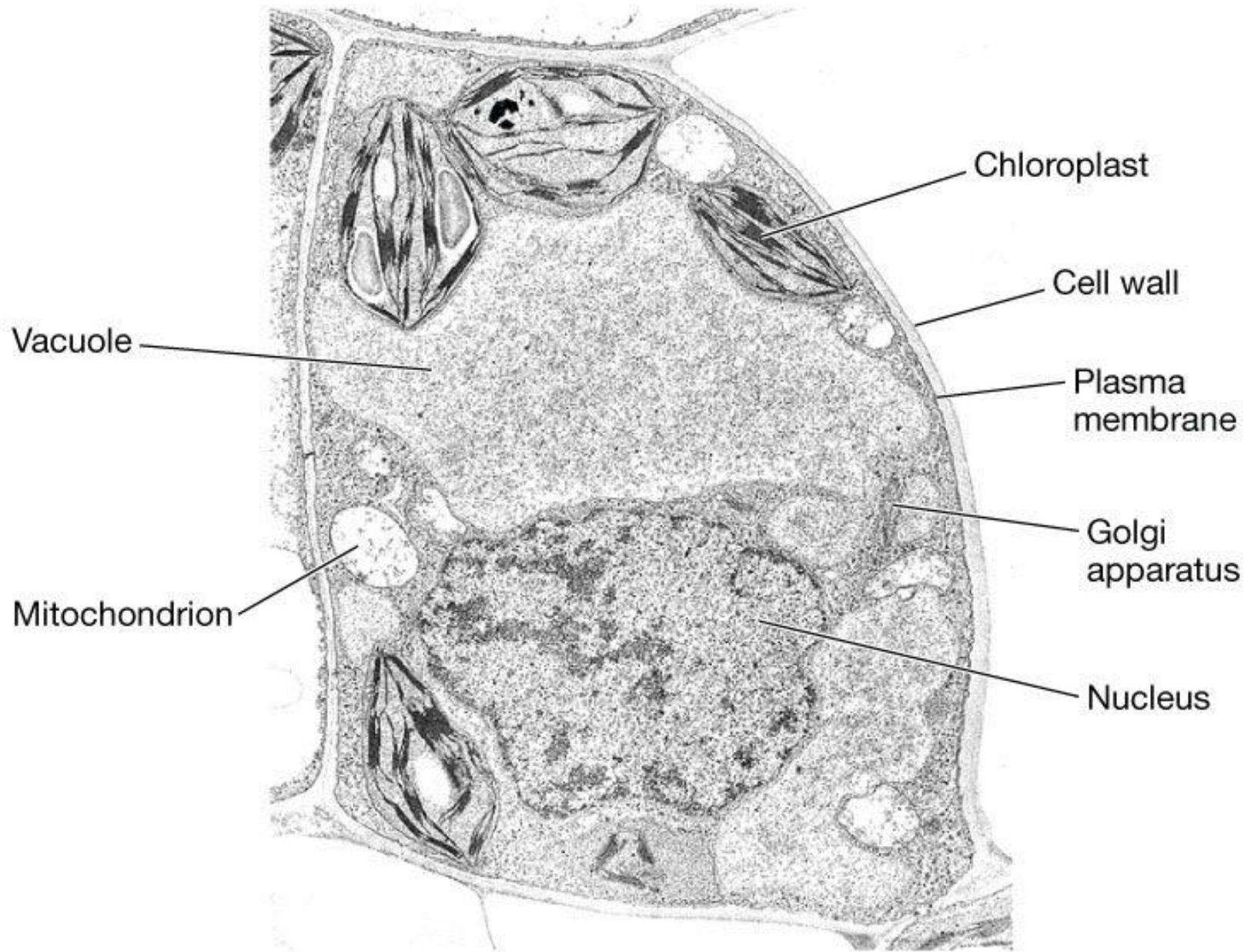
9. Chloroplasts



Chloroplast



9. Chloroplasts



9. Chloroplast

Function:

- **Site of photosynthesis**

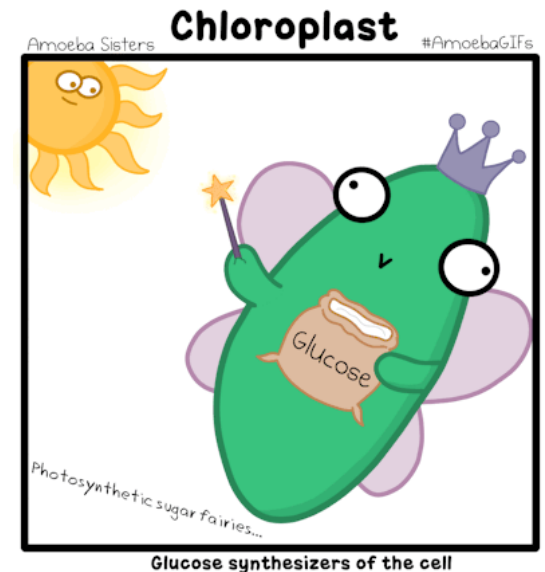
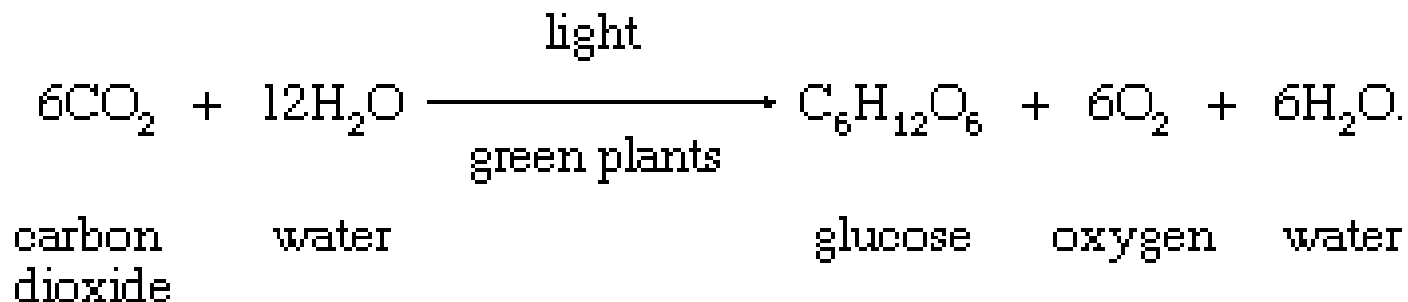
Two main processes in photosynthesis:

1. Light-dependent reaction (aka “light reaction”)

- Light energy absorbed and water is used to **synthesise ATP**

2. Light-independent reaction (aka “dark reaction”)

- ATP used to **convert CO₂ into glucose**

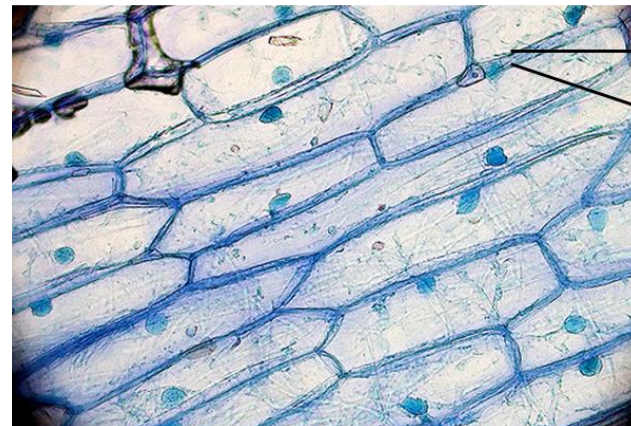
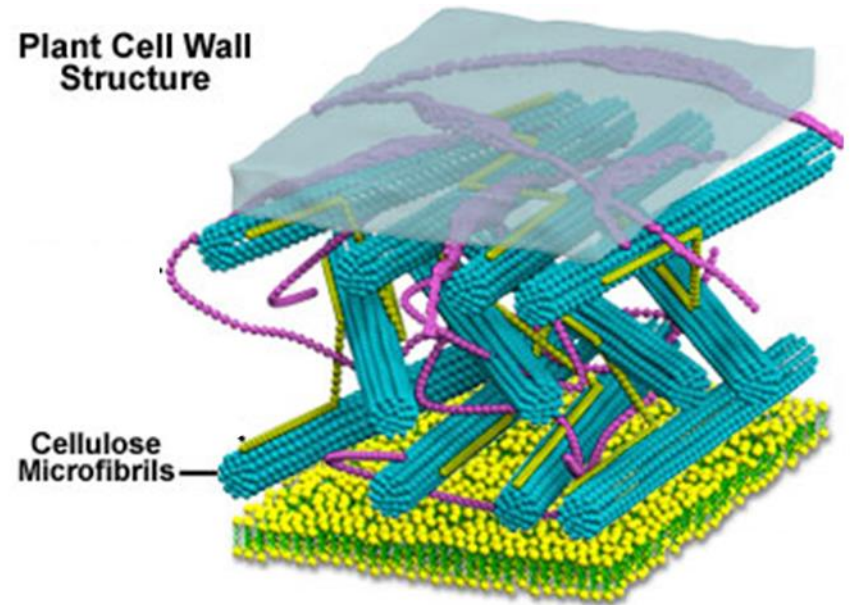


10. Cell Wall

- Thick, rigid layer
- Made of **cellulose**
- **Permeable**
- Bcs there are spaces / gaps between fibres

Functions:

- **Provide structural support**
- **Prevent bursting**
- **Limit cell size**



Cell membrane
Cell wall

11. Plasmodesmata

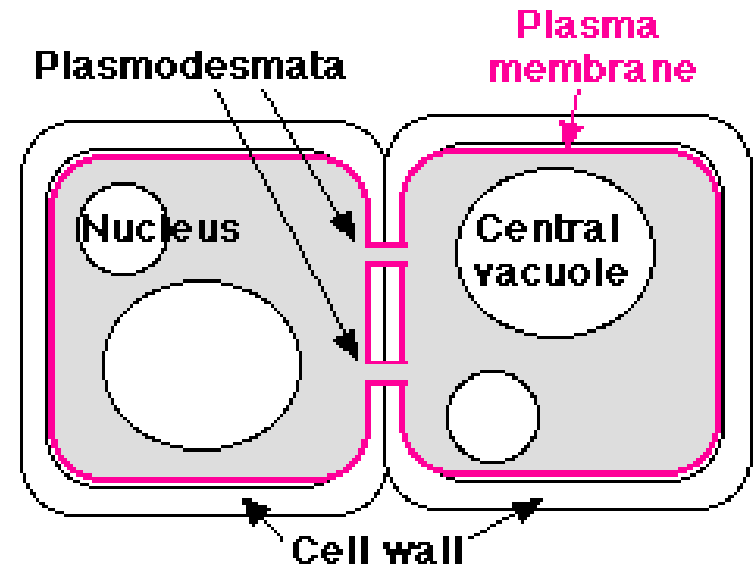
- Strands of cytoplasm passing through channels

Functions:

- **Allows substances to pass**
- **From cell to cell**
- **Without passing through cell walls**

E.g. water, sucrose, amino acids, minerals ions, ATP

- Allows more rapid transport of substances

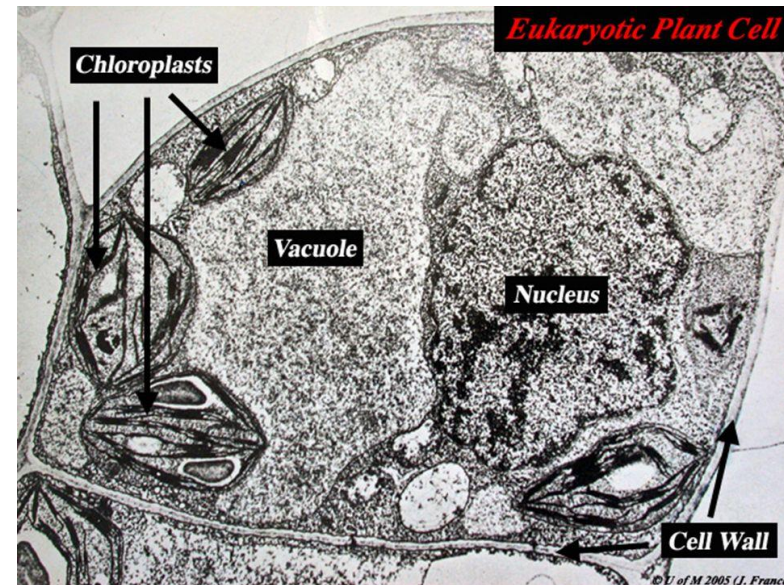
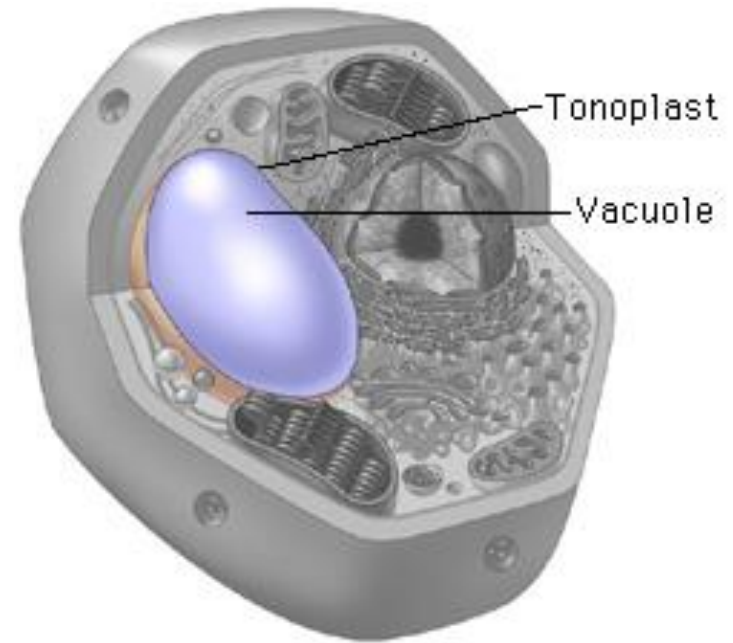


12. Vacuoles and Tonoplast

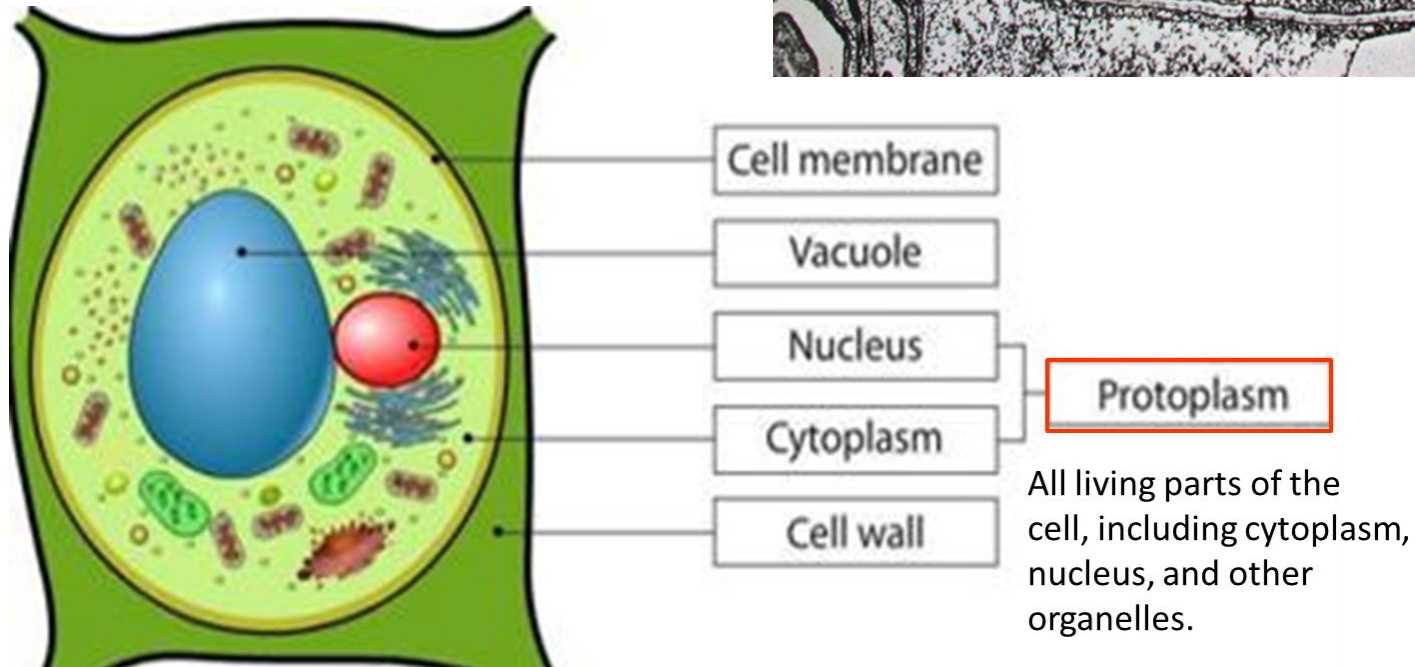
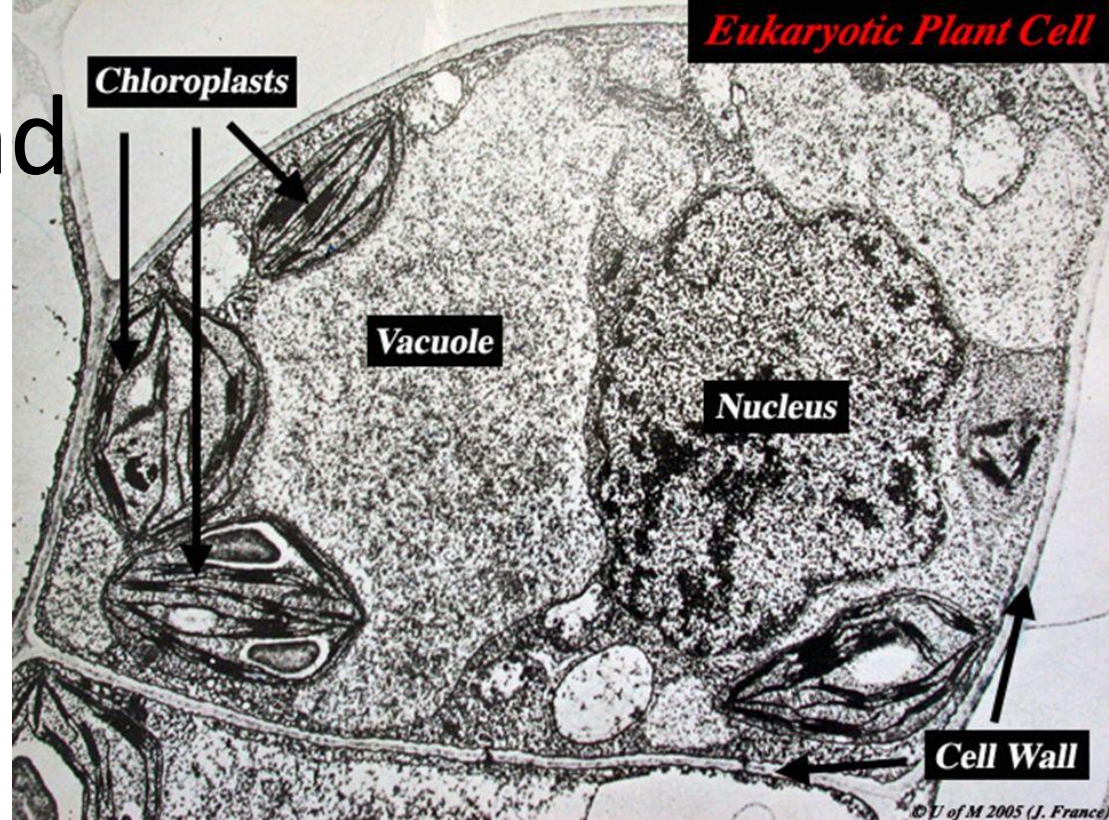
- Commonly found in plant cells
- Large, permanent, central
- Surrounded by a partially permeable membrane called **tonoplast**

Functions:

- **Store of cell sap (contains water, ions, minerals, salts, pigments, sugars)**
- **Stores waste products**
- Pushes chloroplasts to edge of cell
- Gives turgidity to the cell



12. Vacuoles and Tonoplast

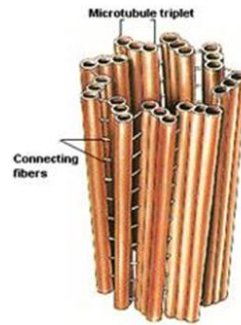


13. Centrioles and Centrosomes

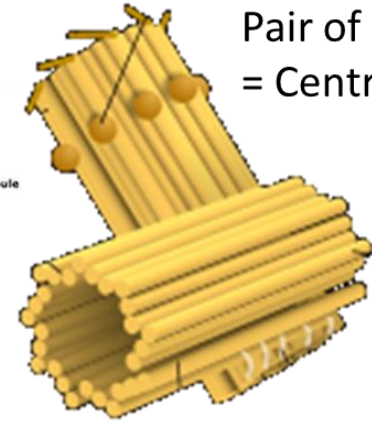
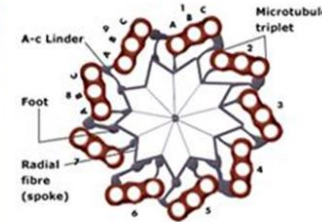
- **Centrioles** are cylindrical
- Made of 9 groups of 3 **microtubules**
- **Not found in plant cells**

Functions of Centrioles:

- **Involved in cell division**
 - Replicates before each cell division and moves to opposite poles
 - Centrioles are found in pairs at right angles (90°) from each other
 - **Forms centrosome**
- Modified centrioles are also found elsewhere e.g. in flagella / cilia
 - Acts as a **Microtubule Organising Centre (MTOC)**
 - **Organises / assembles microtubules**



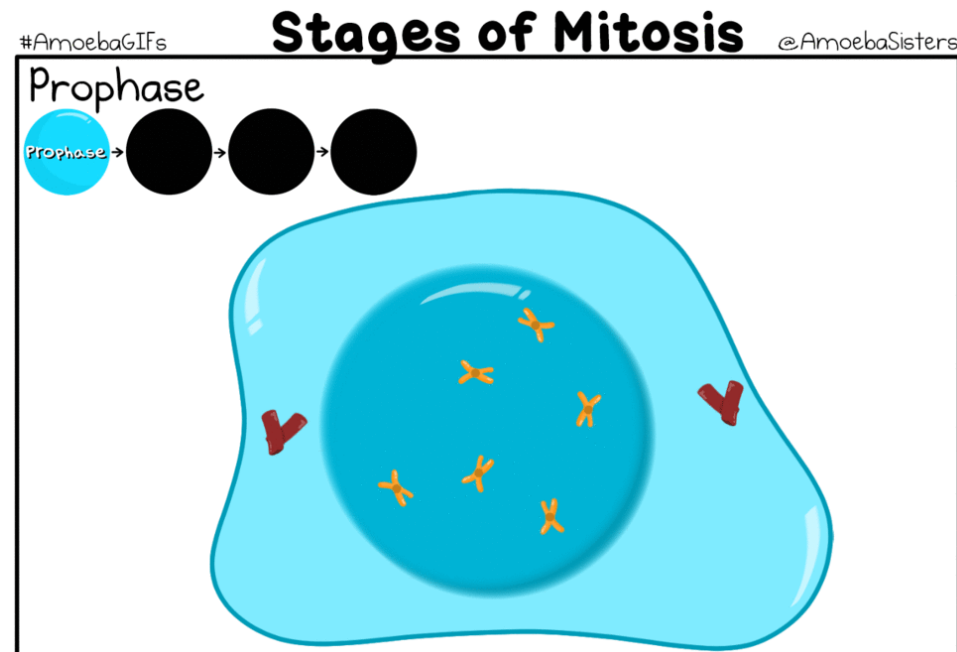
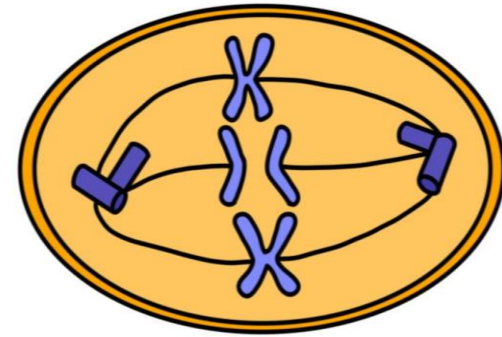
Centriole



13. Centrioles and Centrosomes

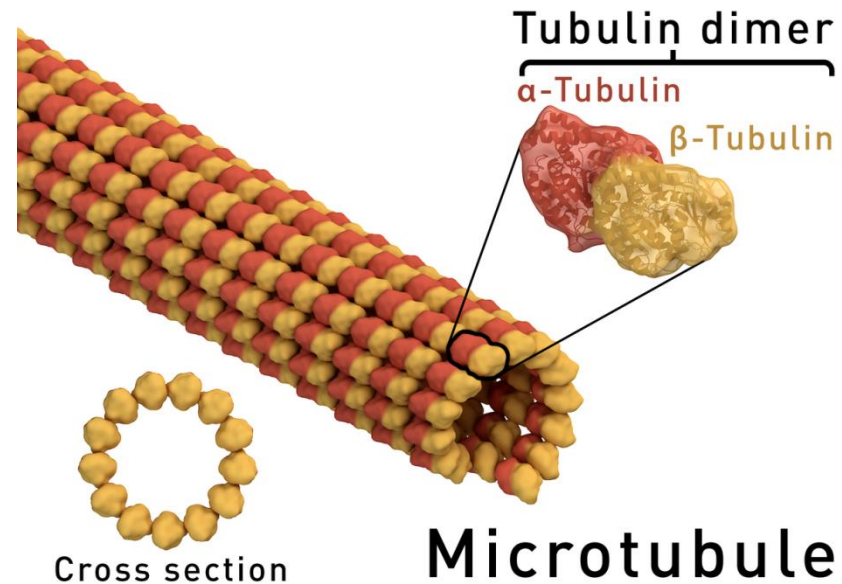
Function of Centrosomes:

- It is a **MTOC**
- **Organises / assembles microtubules**
- For the **formation of spindle fibres**
- At opposite poles
- During cell division /mitosis
- Aid contraction of spindle fibres to separate sister chromatids

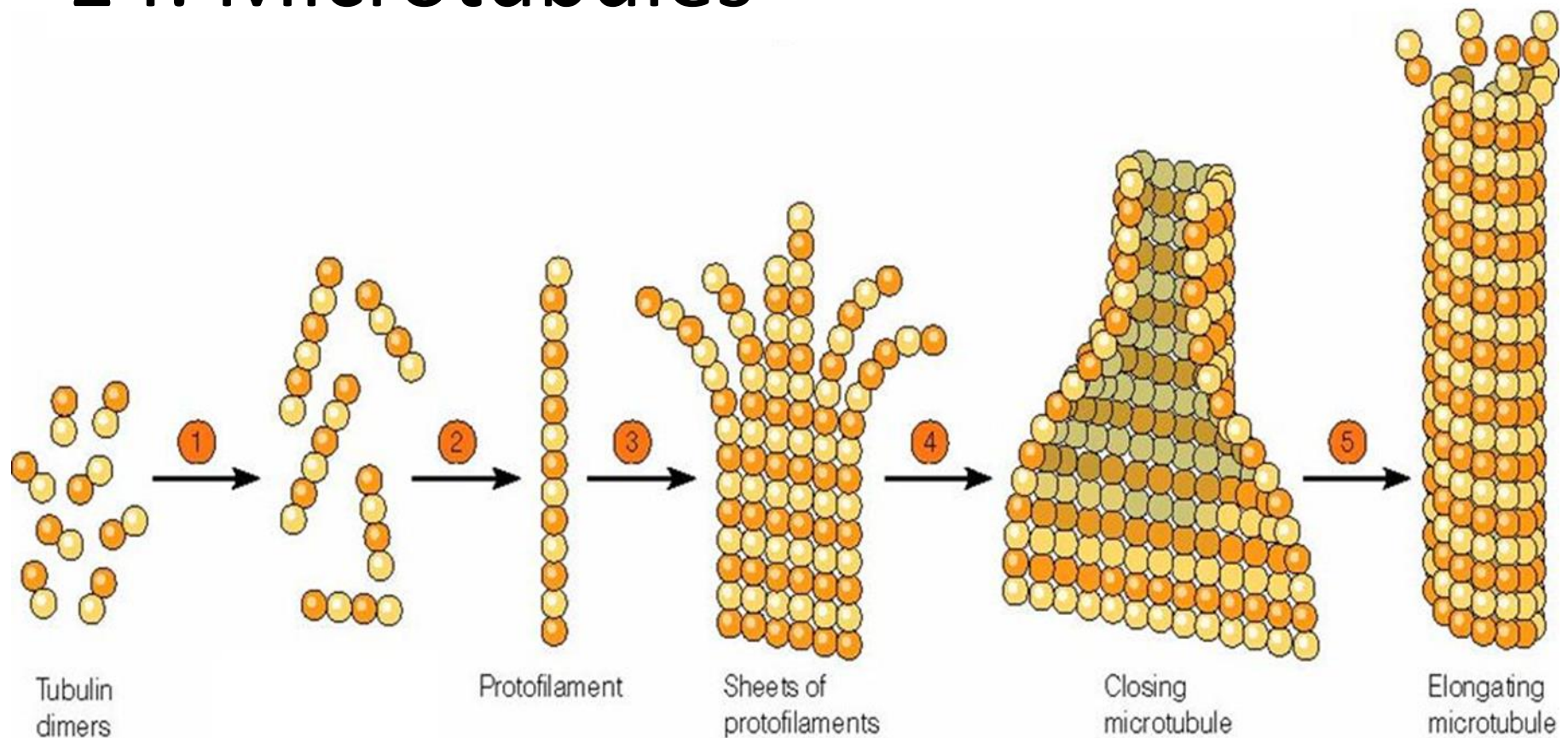


14. Microtubules

- Very small (~25nm)
- Made from **tubulin**
 - Form dimers
 - Dimers polymerise to form long 'protofilaments'
 - 13 protofilaments = 1 microtubule
- Long, rigid, hollow tubes
- Formed and broken down at **Microtubule Organising Centres (MTOCs)**
- E.g. centrosomes, centrioles near flagella/cilia



14. Microtubules

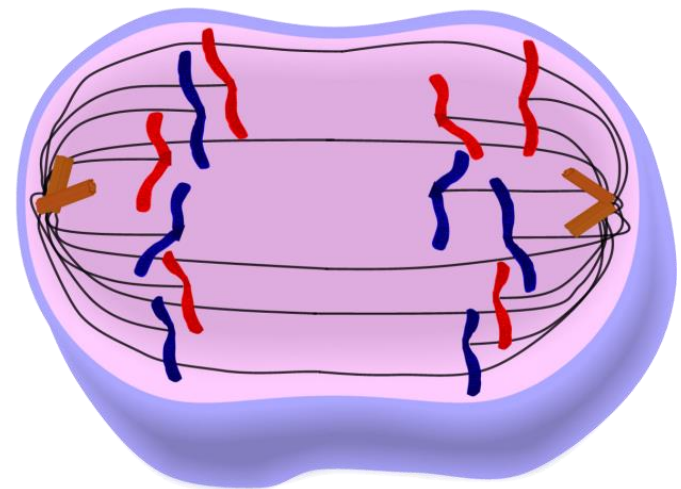
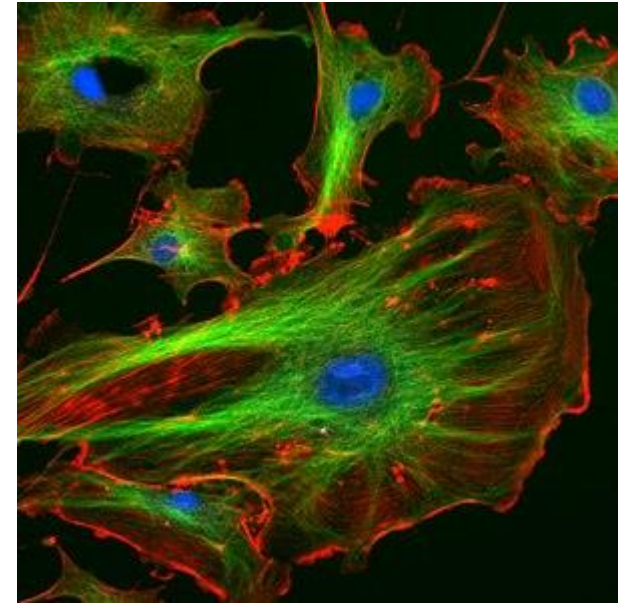


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14. Microtubules

Functions:

- Make up the **cytoskeleton** (together with actin filaments)
 - Provides **mechanical support**
 - Acts as an **intracellular transport system** for movement of vesicles or other components
- <https://www.youtube.com/watch?v=y-uuk4Pr2i8>
- Beating of flagella
- Makes up **spindle fibres and centrioles** used in cell division

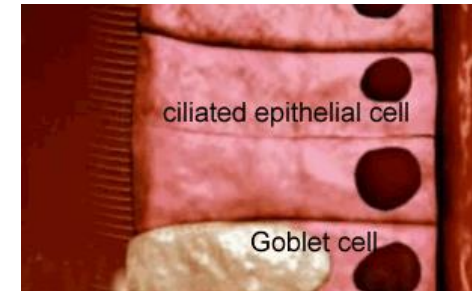
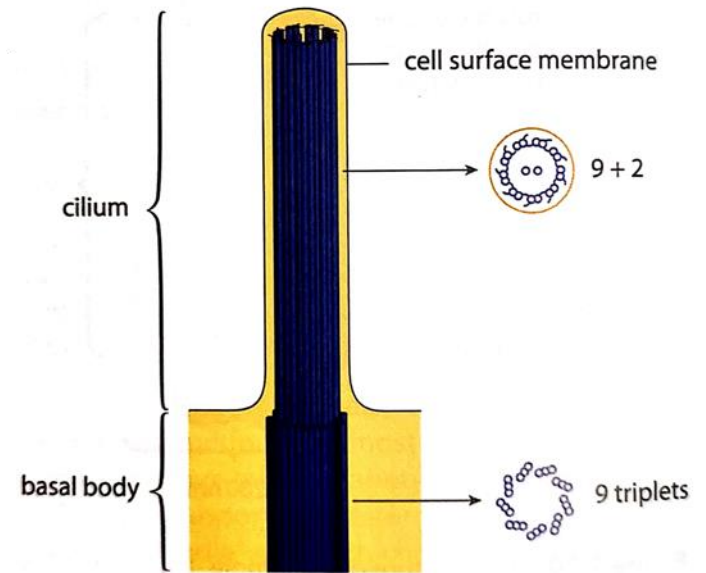


15. Cilia

- Only found in **eukaryotes**
- Smaller in diameter than microvilli
- *Also not to be confused with flagella (mostly found in prokaryotes)*
- Motile / moves rhythmically
- Complicated structure made of **microtubules**

Function:

- **For movement / locomotion**
- E.g. ciliated epithelial cells in lungs, *Paramecium* (eukaryotic microbe)



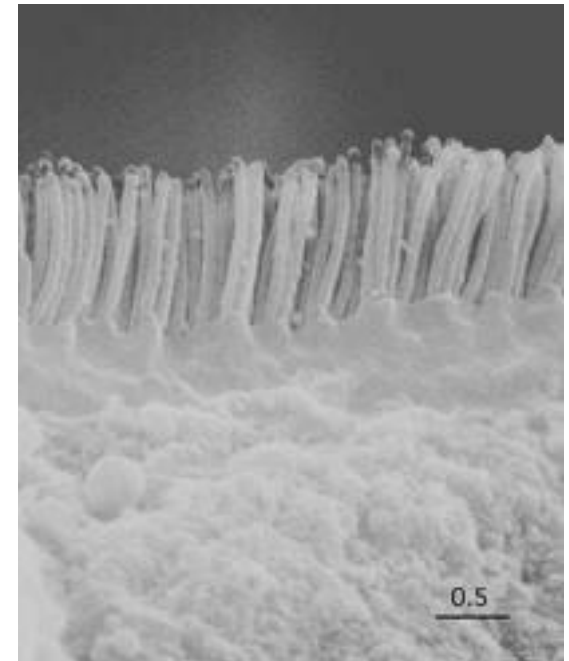
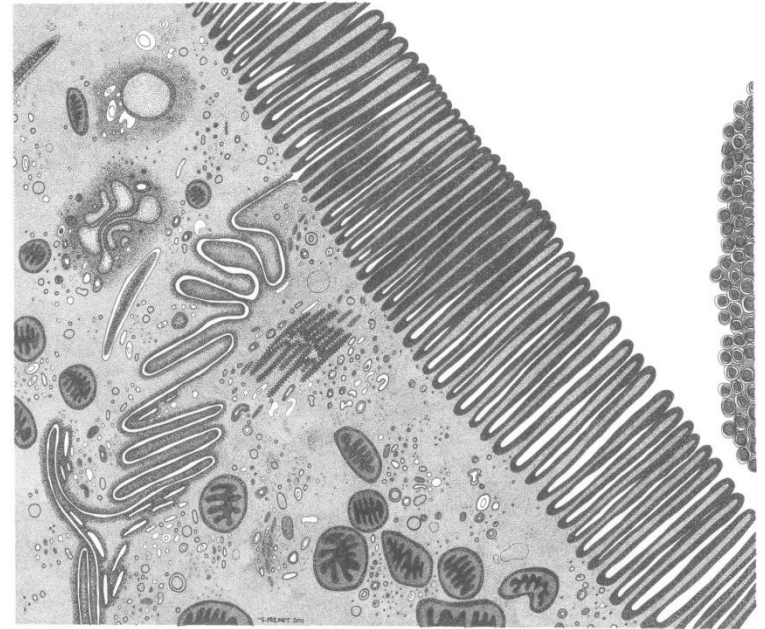
16. Microvilli

- Only found in **animal cells**
- Found on **epithelial cells** in the intestines and kidneys
- Finger-like extensions of the cell surface membrane

Functions:

Increase surface area
of the cell membrane for:

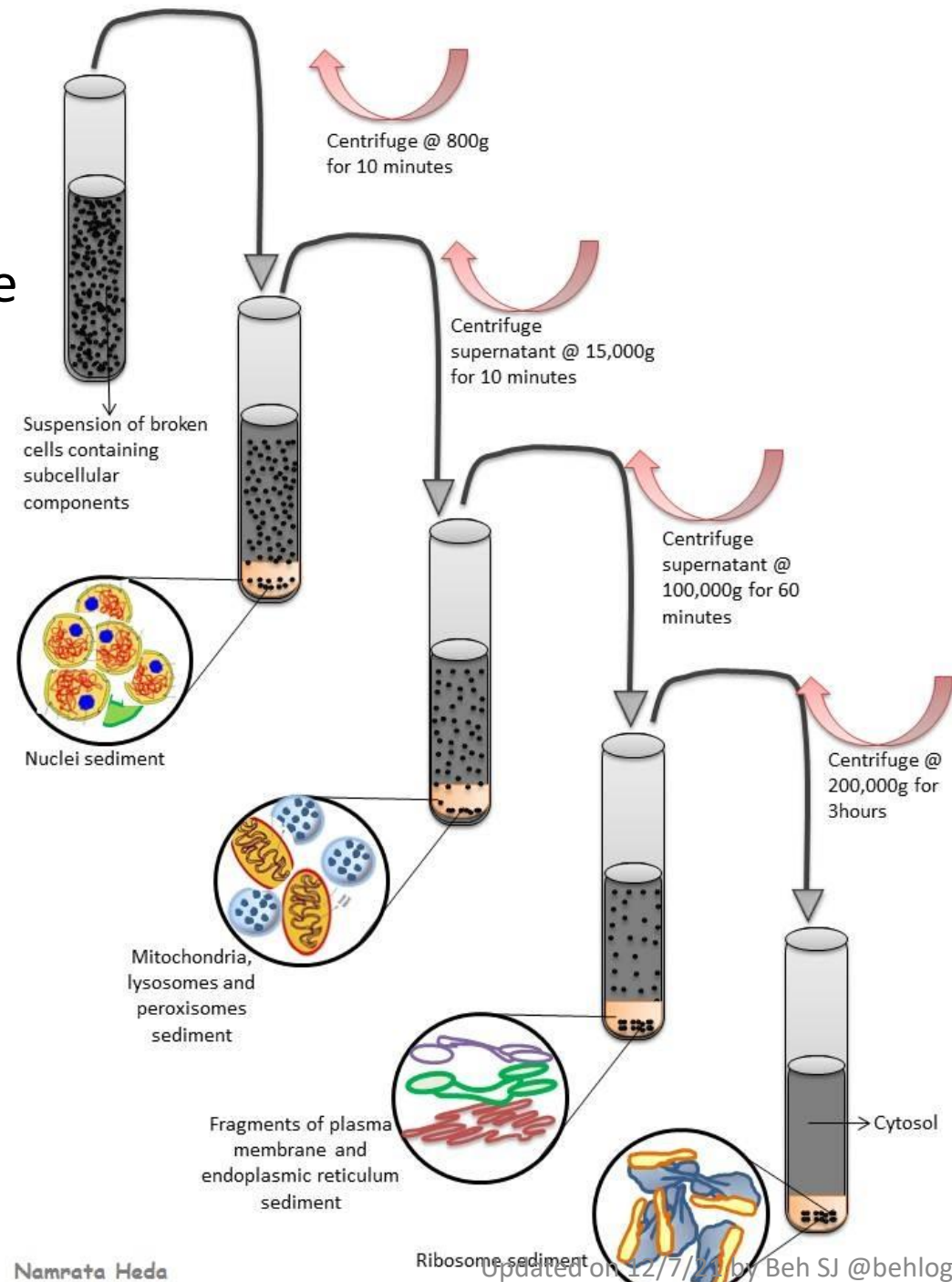
- **Absorption**
- Secretion of enzymes
- Digestion at the cell surface
- Excretion of waste substances



Centrifugation

Q: What happens if we rupture cells and spin them at high speed?

A: The larger structures will sediment first.

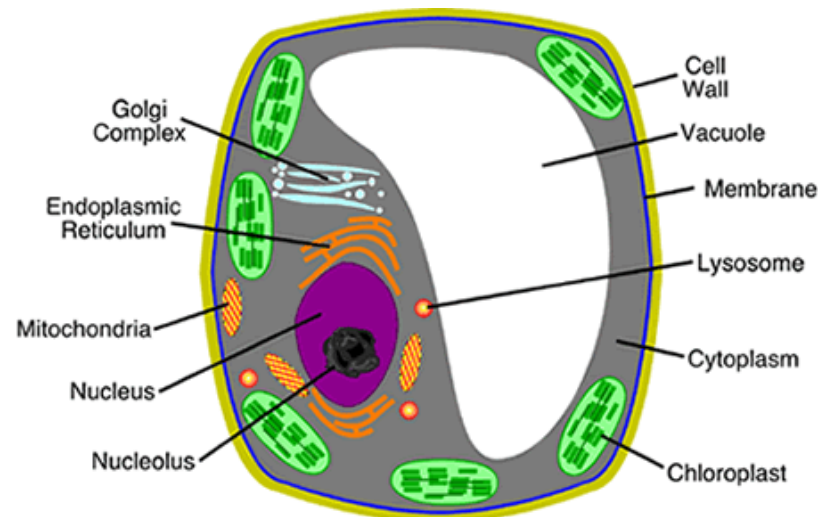
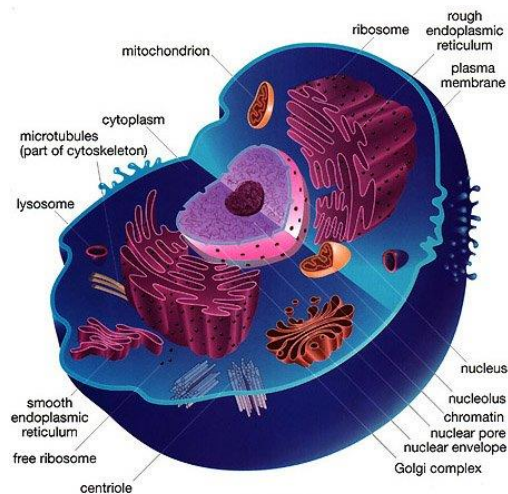


Compare and contrast the structure of an animal cell and a plant cell. [4]

Feature		Animal cell	Plant cell
Similarities:			
Differences:			

Similarities between Animal and Plant Cells

- Plasma membrane
- Nucleus
- Nucleolus
- Cytoplasm
- Other organelles
(eg: mitochondria, Golgi apparatus, ribosomes, lysosomes)

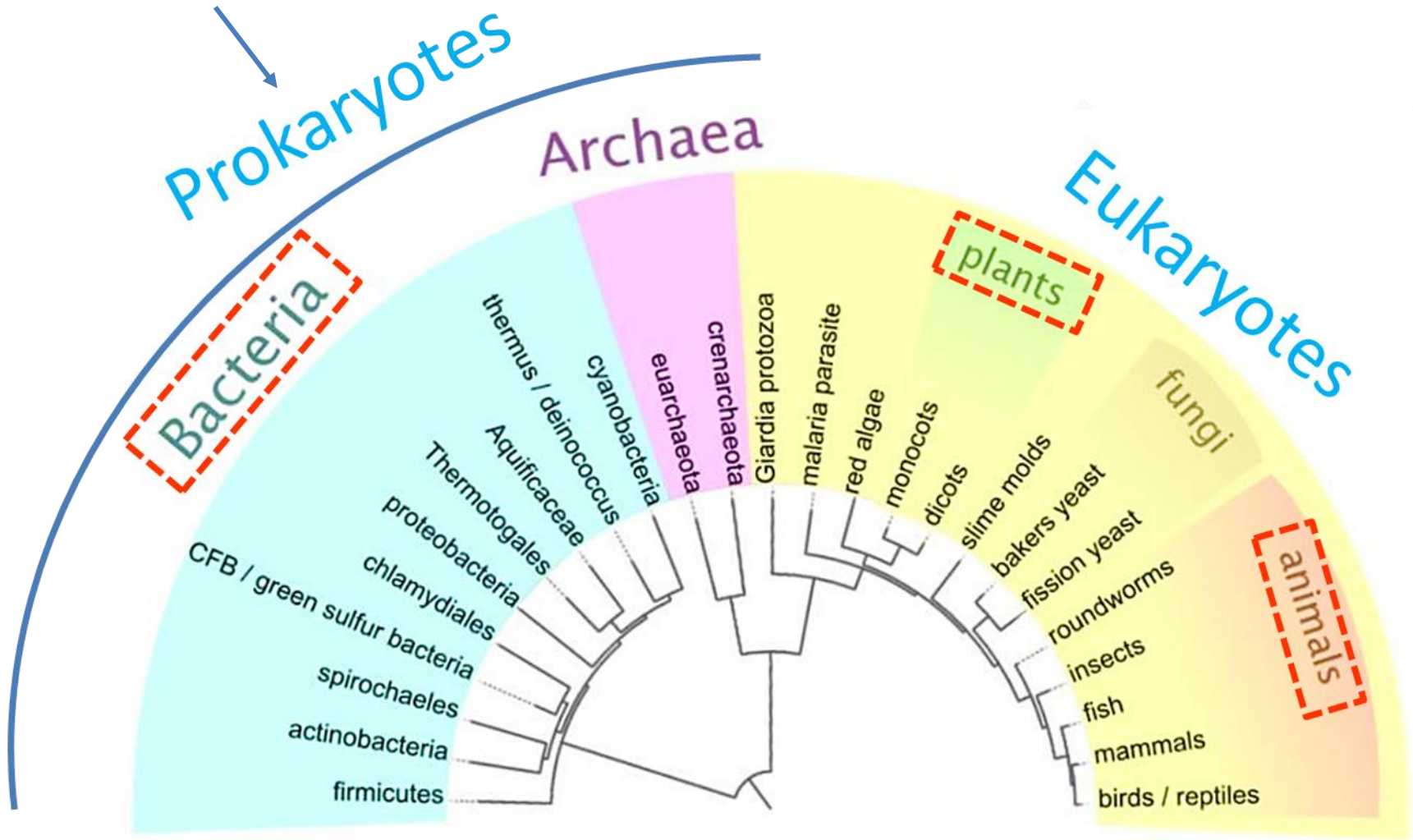


Differences between Animal and Plant Cells

Feature	Animal Cells	Plant Cells
Shape of cell	<u>No</u> fixed shape	Fixed shape
Presence of Cell Walls	Absent	Present
Presence of plasmodesmata	Absent	Present
Presence of vacuoles	Absent, if present, small, temporary	Present, large and permanent
Presence of chloroplasts	Absent	Present
Presence of centrosomes	Present	Absent

Two types of cells: Prokaryotes vs Eukaryotes on the Tree of Life

Now let's talk about
this type of cells!



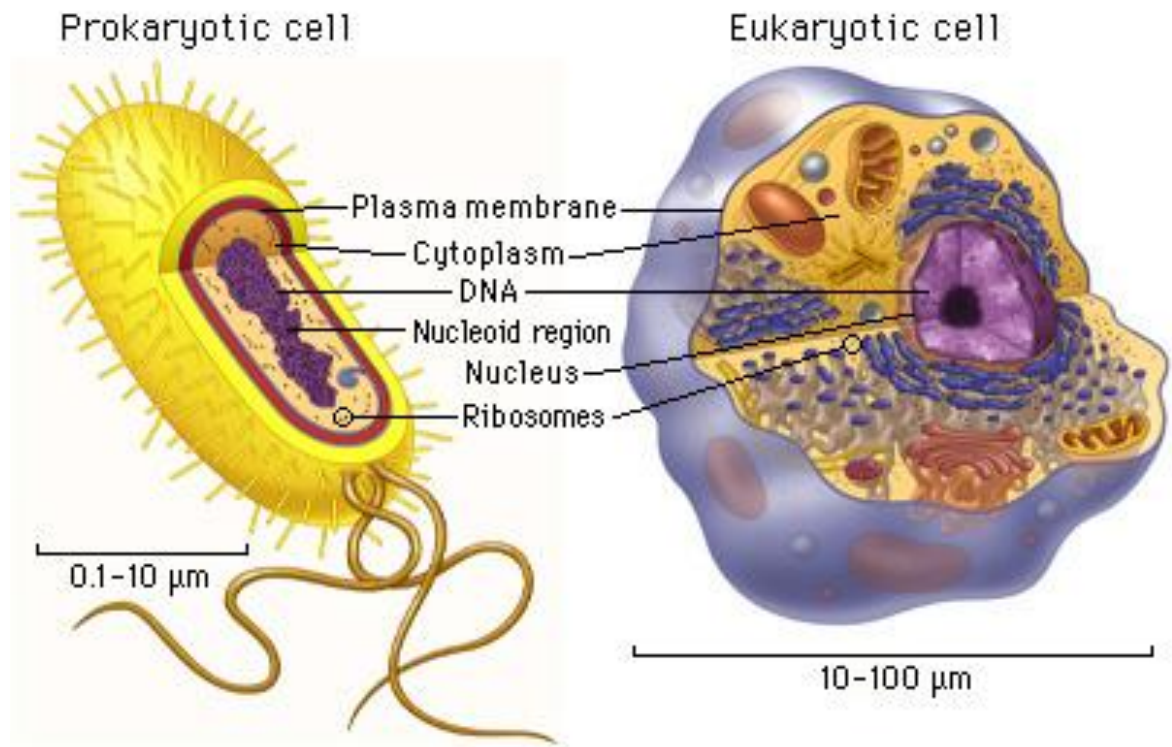
Prokaryotes vs Eukaryotes

Prokaryotes

- pro = before
- karyon = nucleus
- Includes all **bacteria** and archaea

Eukaryotes

- eu = true
- karyon = nucleus
- Includes plants, animals, fungi and other microbes

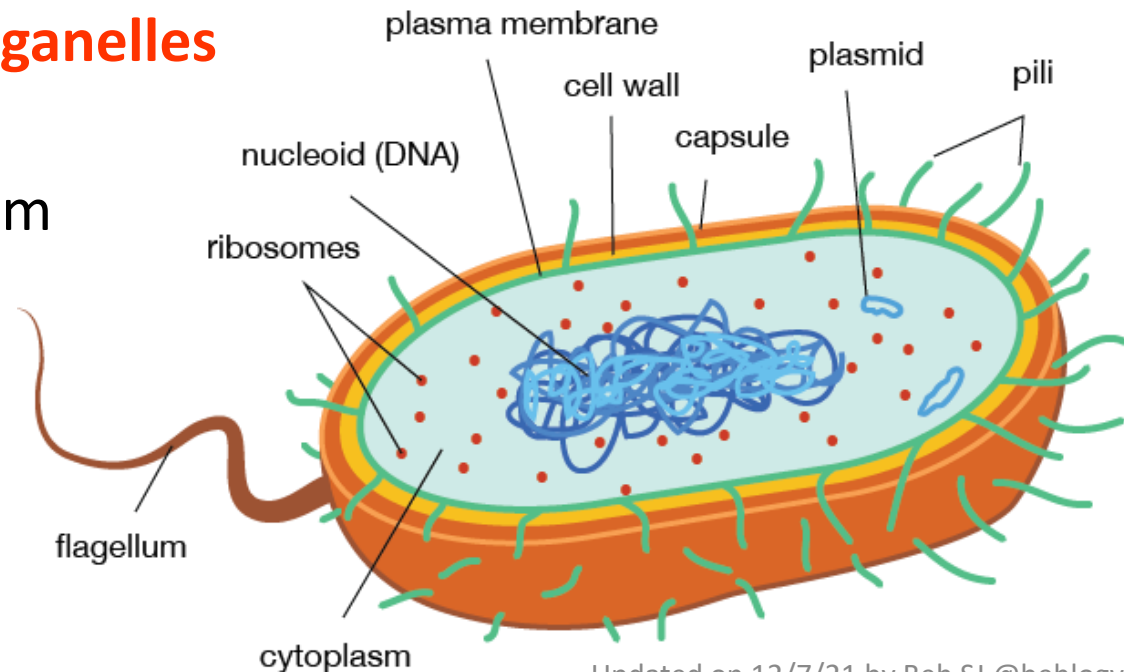


Prokaryotic Cells: A typical bacterium

- **Unicellular**
- Relatively smaller (**1-5 μ m**)
- Simpler in structure
- Divides by binary fission

What all bacteria do not have:

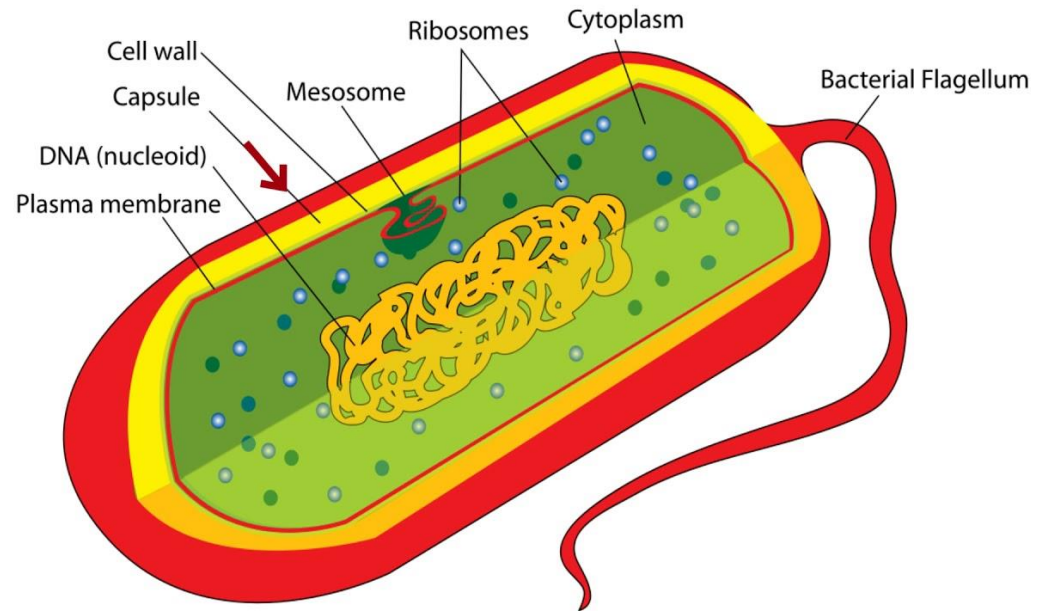
- **No membrane-bound organelles**
- **No nucleus**
DNA lies free in cytoplasm
in the **nucleoid region**



Prokaryotic Cells: A typical bacterium

What all bacteria have:

- Plasma membrane
- Cytoplasm
- **Peptidoglycan cell wall**
 - made of chains crossed linked by amino acids
- **70S ribosomes**
- **Circular DNA**
- DNA is **naked**
 - not associated with proteins

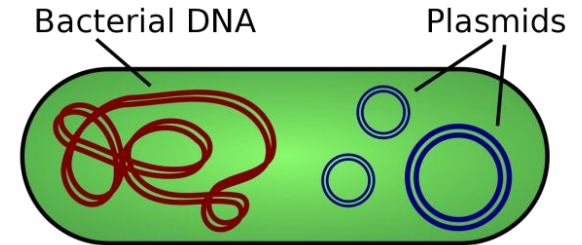


Prokaryotic Cells: A typical bacterium

What is only present in some bacteria:

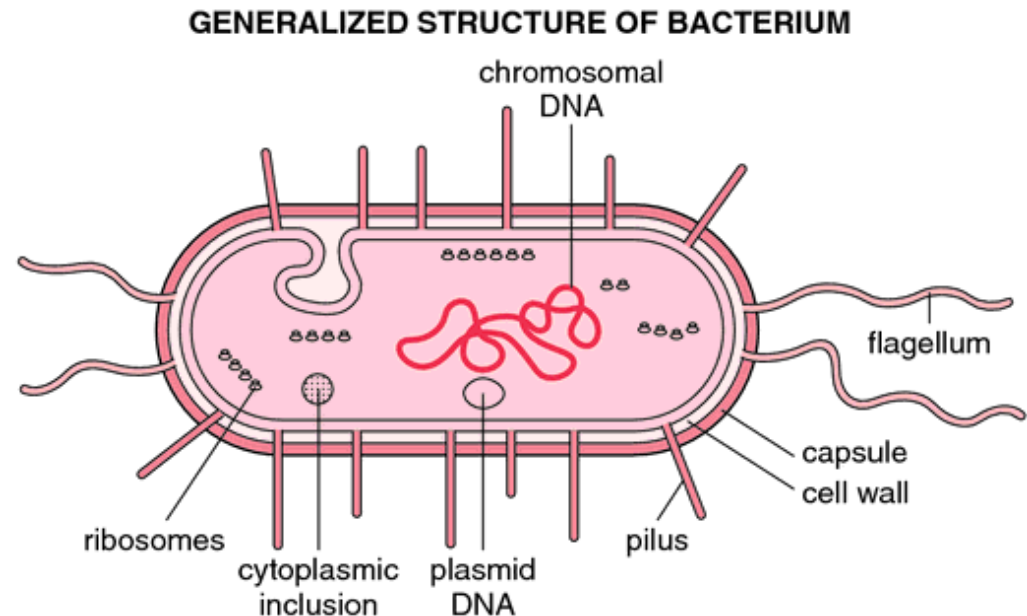
1) **Plasmids**

- **Small, circular DNA**
- **Codes for non-essential proteins**
- Several may be present



2) Pili

- Sexual reproduction
- For attachment to other cells/surfaces



Prokaryotic Cells: A typical bacterium

3) **Flagellum**

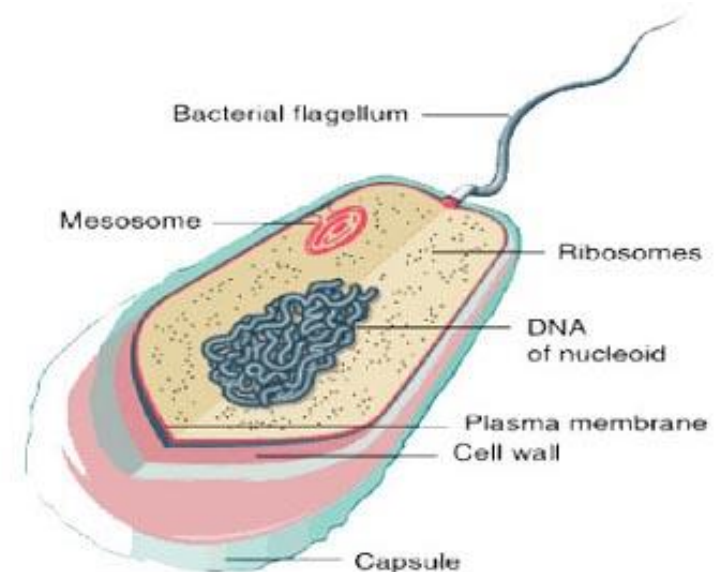
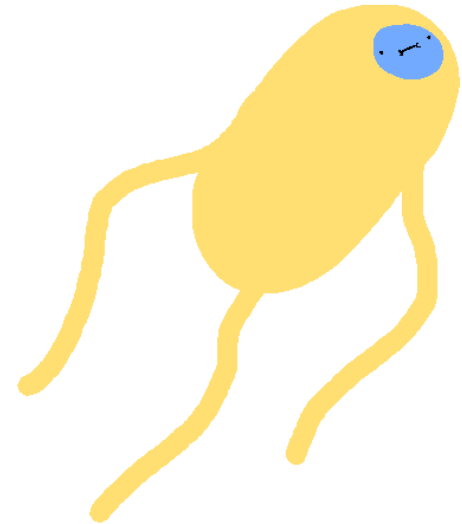
- Locomotion

4) **Capsule**

- Outer coat, additional protection
- Attach to surfaces

5) Infoldings of plasma membrane (mesosomes)

- For photosynthesis / nitrogen fixation



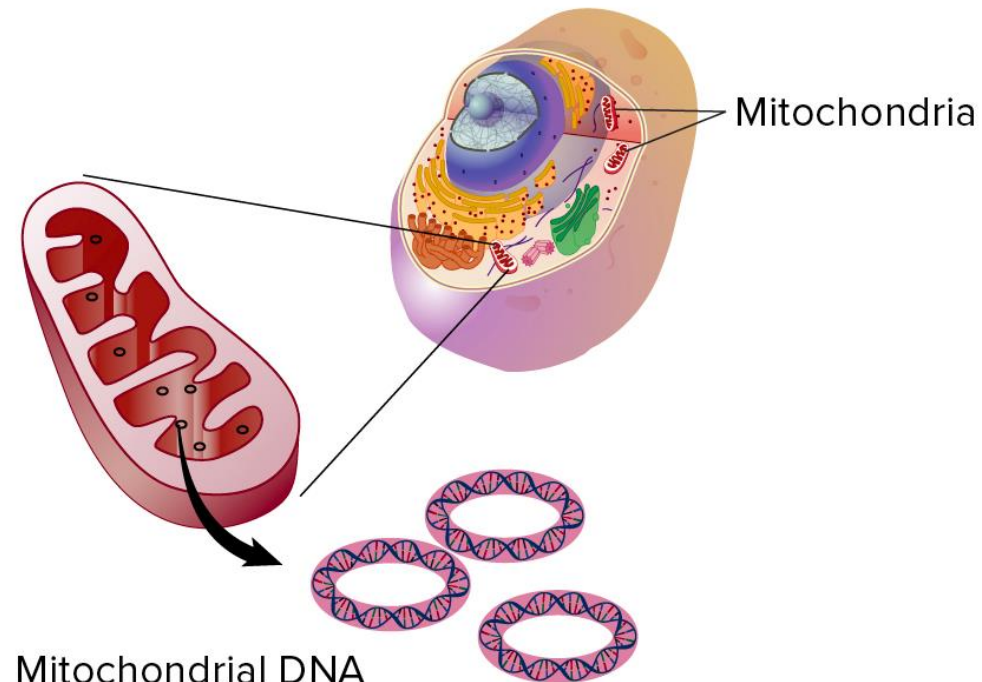
Prokaryotes, Mitochondria and Chloroplast

They have a lot in common!

Both have:

- Similar size
- Small, circular DNA
- 70S ribosomes
- Division by binary fission

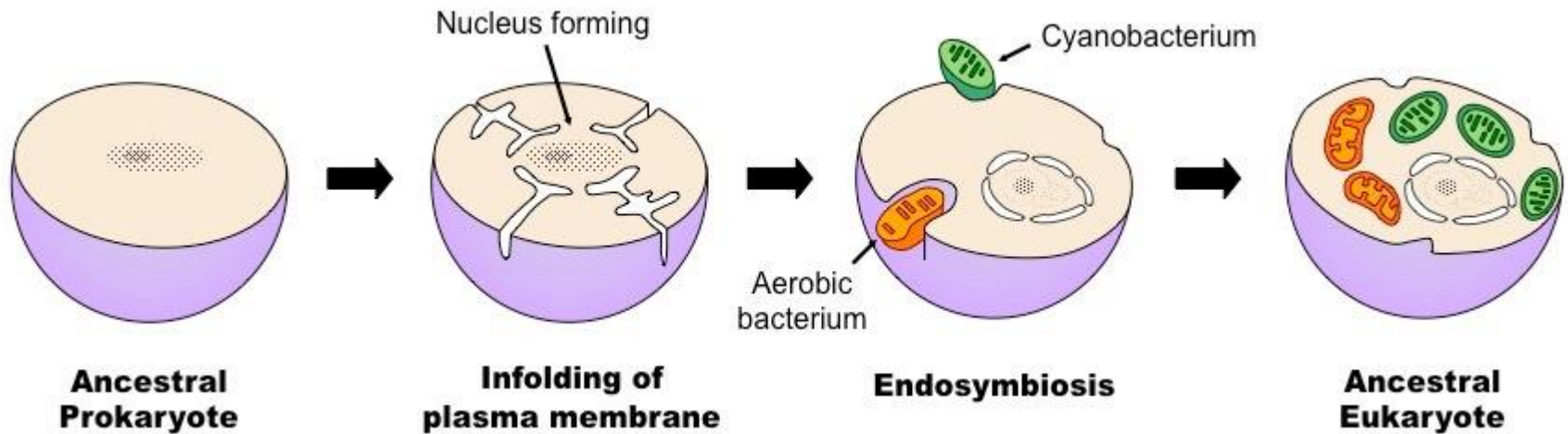
But why???



Prokaryotes, Mitochondria and Chloroplast

A: The Endosymbiotic Theory

<https://www.youtube.com/watch?v=FGnS-Xk0ZqU>



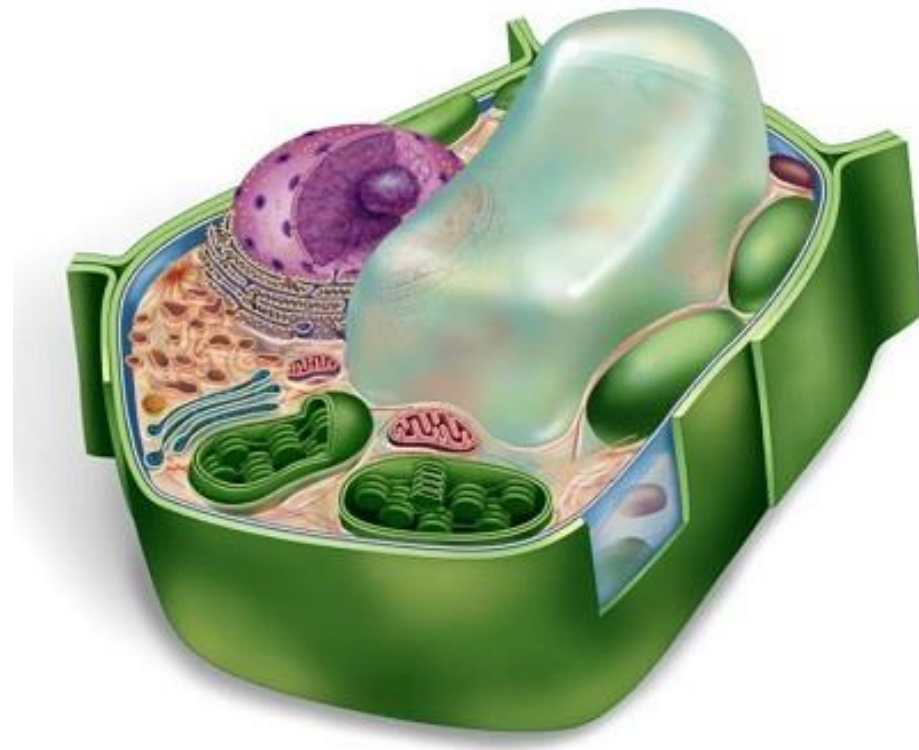
P/S: This is not in syllabus!

Compare and contrast the structure of a eukaryotic cell and prokaryotic cell. [4]

	Feature	Prokaryotic cell	Eukaryotic cell
Similarities:			
Differences:			

Eukaryotic Cells

- Larger (~10-100 μm in diameter)
- **Has membrane-bound organelles**
- Has nucleus
- DNA is **linear**
- **DNA associated with proteins**
- Larger **80S** ribosomes
- Cellulose cell walls (plants)
- Chitin cell walls (fungi)



Viruses

- **Non-cellular** structure
- ~50 times smaller than bacteria (20-300nm)
- Much simpler
- No plasma membrane, cytoplasm, ribosomes
- Only:

1. Nucleic acid core = **DNA or RNA**

2. **Capsid** = protein coat

- Protective coat

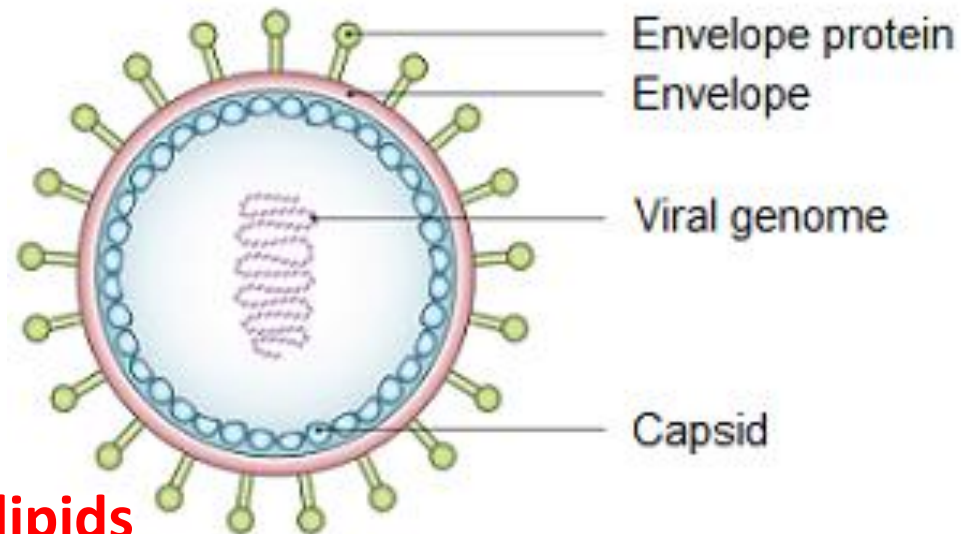
- May have one or two coats

3. Some viruses also have an

outer envelope made of phospholipids

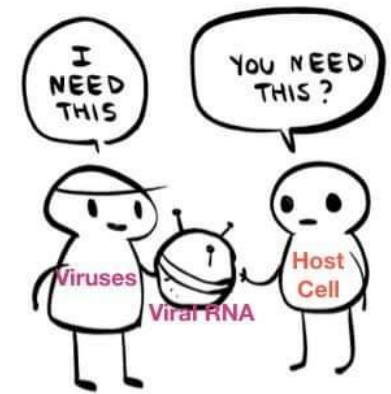
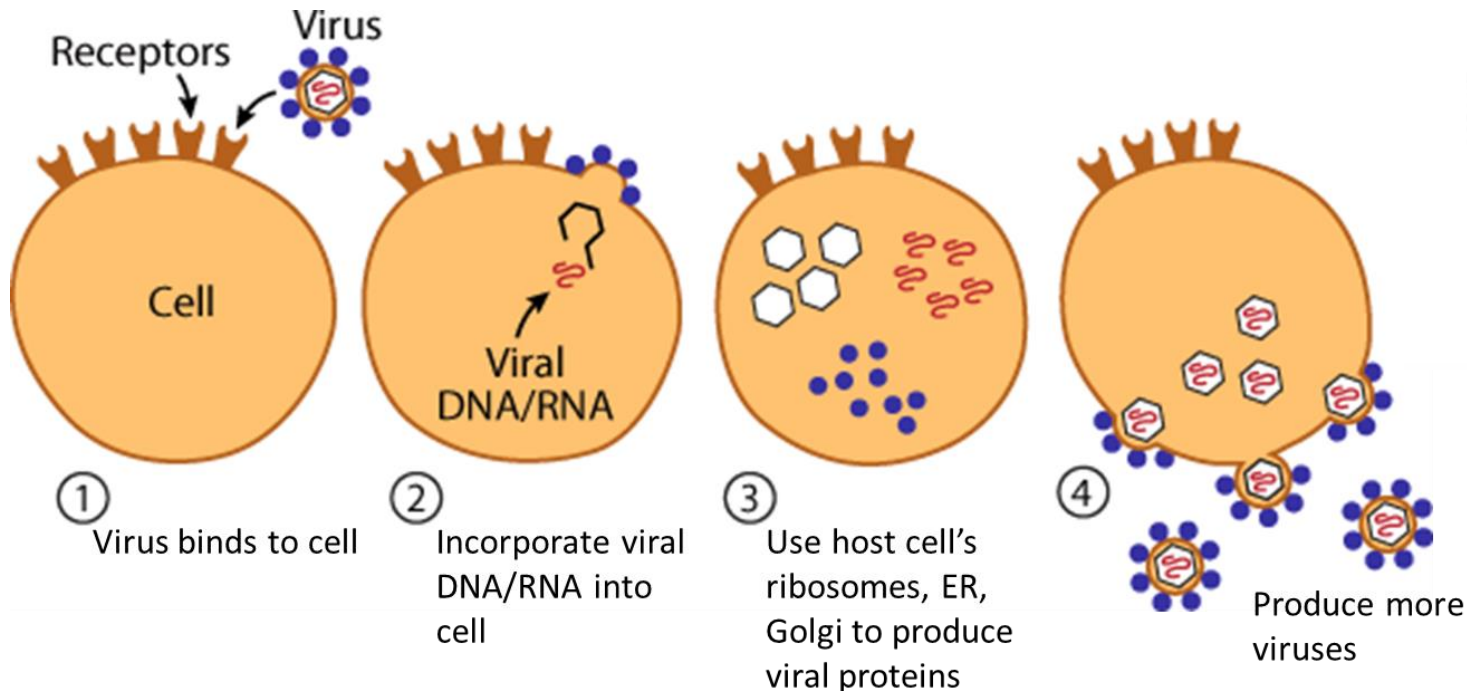
4. Some proteins may be present

- e.g. haemagglutinin, neuraminidase



Viruses

- All **parasitic**
- Can only reproduce by **infecting** living cells
- **Uses protein synthesising machinery** of host cell to replicate
- Are they considered living?



List of Eukaryotic Cell Structures

Plant + Animal Cells included!

You need to:

1) Name it

2) Recognise it

3) Know its function

1. Cell surface membrane
2. Nucleus, nuclear envelope and nucleolus
3. Ribosomes
4. RER
5. SER
6. Golgi body
7. Lysosomes
8. Mitochondria

9. Chloroplast
10. Cell wall
11. Plasmodesmata
12. Vacuole and tonoplast
13. Centrioles
14. Microtubules
15. Cilia
16. Microvilli

Important Terms to Remember

Pay attention to those **bold, highlighted red text** and what's emphasised in class!

In addition to the list of 16 eukaryotic cell structures to remember:

Bacteria (Prokaryote)

(No membrane-bound organelles)

1. Nucleoid region
2. Peptidoglycan cell wall
3. Circular DNA
4. 70S ribosome
5. Plasmids

Virus

1. DNA / RNA
2. Capsid (protein coat)
3. Envelope

Chapter Outline

Part 1: Microscopy

- Magnification vs Resolution
- Light Microscope vs Electron Microscope

Part 2: Micrometry: How do we measure cells?

- Calibrating EPG using the Stage Micrometer (Practical 1)
- Magnification

Part 3: Cell Structure and Function

- Organelles
- Animal vs Plant cells
- Eukaryotes vs Prokaryotes
- Viruses

Videos

OK warning! All videos are for **reference and entertainment only** and ALWAYS contain too much/ too little/irrelevant info.

Seeing the Invisible: van Leeuwenhoek's first glimpses of the microbial world:

<https://www.youtube.com/watch?v=ePnbkNVdPio>

Principles of electron microscopes

<https://www.youtube.com/watch?v=ljTEG-B-kGc>

Organelles involved in protein synthesis

<https://www.youtube.com/watch?v=26y1PCkWilc>

Inner Life of the Cell (3:00 onwards – it's hard to understand what he is saying, but the 3D animations gives you a clue on how the cytoskeleton works and how protein production relies on it too!)

<https://www.youtube.com/watch?v=FzcTgrxMzZk>

Inside the living cell

<https://www.youtube.com/watch?v=d4TJ4NY1IA0>